Electronic Services - Los Angele
M10284X

Edward A. Sadim
PT - F

INSTRUCTIONS

BAILEY METERS

BAILEY METER COMPANY

CLEVELAND • OHIO

GENERAL ELECTRIC CO.
Instrument Div. & Control
228 W. Florence Ave.
Inglewood, Calif. 90301

GENERAL ELECTRIC CO.
Instrumentation & Control
228 W. Florence Ave.
Inglewood, Calif. 90301

BAILEY METER COMPANY
INSTRUCTION BOOK

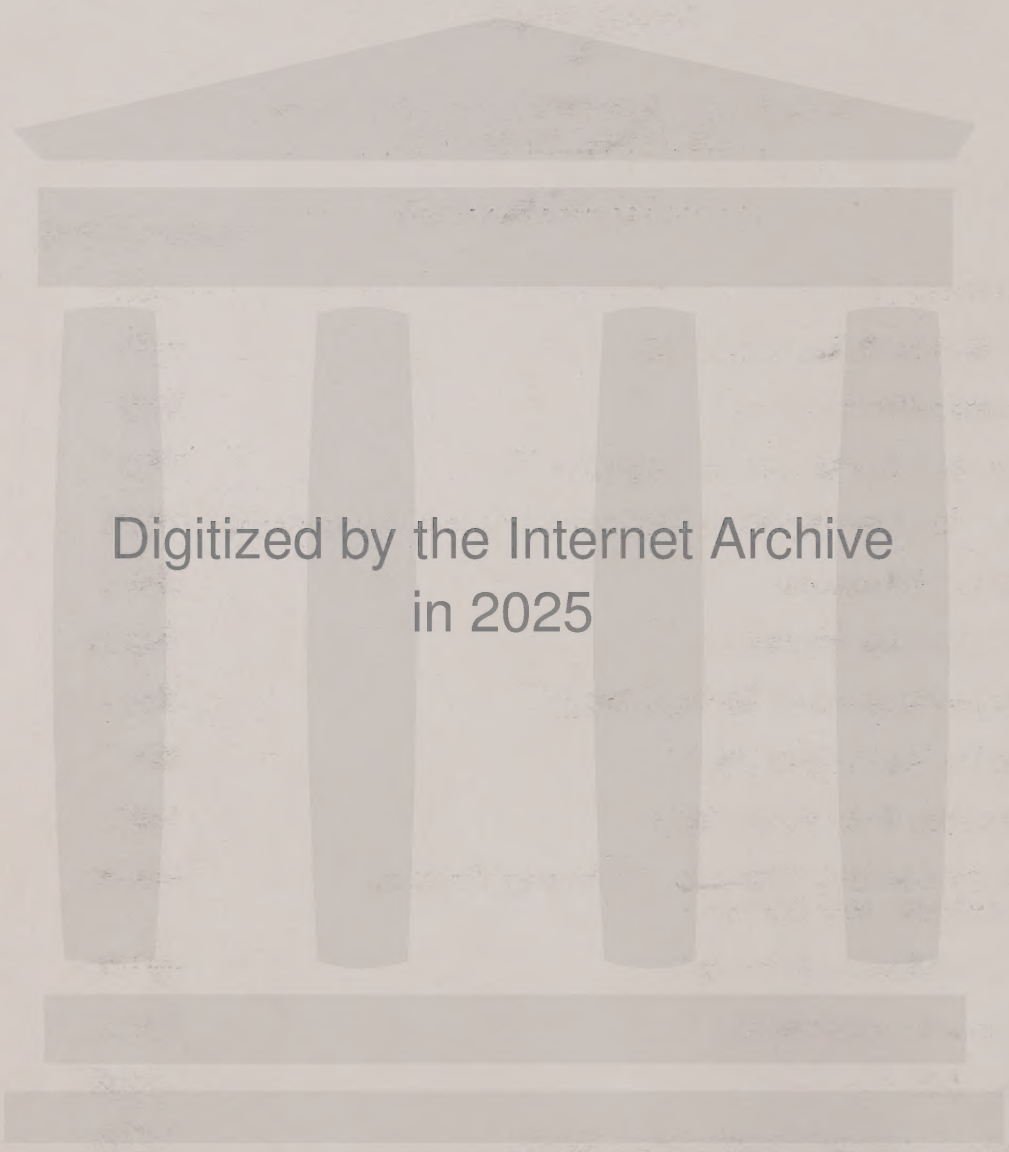
The contents of this Instruction Book describe and illustrate the installation, operation and maintenance of Bailey Meter Equipment. The instructions should be followed carefully in order that the equipment might give optimum service.

No mechanical or electrical equipment can long remain in good operating condition if not inspected regularly and minor repairs and adjustments made as required. *For this resaon, we recommend the appointment, as soon as the equipment is received on the premises, of a competent engineer or operator who will be put in direct charge of this equipment and who will see that proper attention is given to it at all times.*

This operator should also be made responsible for keeping the meter keys, charts, ink, and other operating and repair parts and should also be given the duty of changing the charts daily, keeping the pens inked, etc.

THIS INSTRUCTION BOOK SHOULD BE GIVEN TO THE OPERATOR WHO WILL HAVE CHARGE OF THE INSTALLATION AND MAINTENANCE OF THE EQUIPMENT.

Form 135



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ORDER NO.17547-S S.O. 326101-6

BAILEY METER COMPANY
CLEVELAND, OHIO

INSTRUCTIONS
FOR

CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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A3O4782 D536652
A3O7451 D661980
A3O7452

Control Piping Diagram Drawing No. B3O7164

PK:PK

SPECIFICATION SHEET

FLUID METERS AND BOILER METERS

BAILEY METERS

5

FIRM California Institute of Technology
PLANT
LOCATION Pasadena, Calif.

Date Nov. 12, 1945
Our S. O. No. 228101
Purchase Order No. 17547-S
BY

Sheet No. 1

	BAILEY Tele- METER DATA			DESIGN DATA		
1	Type CS1 Class W		29	To Measure Flow of	Specific Gravity Fluid	
2	Serial No. 100640T		30	Maximum Capacity	15 GPM	
3	Meter for 1.04 Specific Gravity Fluid		31	Maximum Meter Differential	300	inches of water
			32	STEAM — Pressure		psi. gage
4	Chart No.		33	Superheat	F., or Moisture	%
5	Chart Reading X		34	Total Temperature		F.
6	Scale Reading X		35	Specific Volume		cu. ft./lb.
7	Integrator Reading X		36	WATER — Pressure		psi. gage
8	Integrator Gears: Driver Driven		37	Temperature	F., Density	lb./cu. ft.
9	Pen Color			GAS OR MIX	Specific Gravity Fluid	
				Flowing Conditions		Standard Conditions
10	Rating 115 Volts 60 Cycles		38	Pressure	910psi	
11	Wall Panel Mounted		39	Barometer:		
			40	Temperature	70° F.	F.
	BOILER OR RATIO METER AIR-FLOW MECHANISM		41	Saturation	%	%
12	Air-flow Bells: Rectangular — Part No. 311734C1 Round — Part No. 312083A1		42	Sp. Gravity (dry basis)	1.04	
13	Air-flow Displacer: Large — Part No. 311745C2 Small — Part No. 311745C1		43	Specific Volume or Density	64.00	
14	Use Sealing Oil — In A. F. Mechanism		44	Orifice Material	Stainless Steel	
15	Diaphragm A.F. Mech. Displacer: Small — Part No. 312271B1 Large — Part No. 312271D2		45	Orifice Plate Outside Diameter	2-1/16"	
16	Indicating Scale Range:		46	Thickness of Orifice Plate	1/16	Inches
	PRIMARY ELEMENT INSTALLATION DATA		47	Orifice Hole Diameter	.470	Inches
17	Serial No. Orifice, 72799		48	Ratio, hole or throat to pipe Diameter	.5936	
18	Venturi Tube Laying Length		49	Hole Eccentric		Inches
19	Drawing No.		50	Height of Segment		Inches
20	LOCATE in 1" Pipe Horiz. flow below meter		51	No. Drain Holes 1	Diam. Drain Hole 3/32	Inches
21	Straight Pipe Inlet 3 ft.		52	Locate Drain Hole at	top	of Pipe
22	Preceded by		53	Beveled or Not on Outlet Side	Bevel	
23	Straight Pipe Outlet Str. Pipe + Valve		54	No. Centering Pins	Size Centering Pins	
24	K1= 5-7/8 Inches. Tap for 1/2" Pipe Thread			Remarks This sheet covers transmitter only. For receiver, see Sheet No. 2, S.O. 228101.		
25	K2= 5/8 Inches. Tap for 1/2" Pipe Thread					
	K1 is connection on inlet side. K2 is on outlet side					
26	Drill K1 and K2 into side	of pipe				
27	Inside Pipe Diameter at K1= .807	Inches				
28	Inside Pipe Diameter at K2= .8095	Inches				

AUXILIARY RECORDER DATA			CONTROLLER DATA
Class			Piping Diagram
Service			Operated by
Serial No.			
Range	to	to	Range
Pen Travel	Chart	Chart	Operating Std.
Pen Color			Calibrated for
Position			
Pen Length	Inches	Inches	An Increase in
Capillary Length	Feet	Feet	Increases Decreases Loading Pressure
Bulb Dia. and Material	"—	"—	And
Active Bulb Length			
Bulb Inserted			

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SPECIFICATION SHEET

AC ELECTRONIC RECORDER OR INDICATOR

FIRM California Institute of Technology
PLANT
LOCATION Pasadena, California

Date Nov. 12, 1945
Our S. O. No. 228101
Purchase Order No. 17547-S
BY

Sheet No. 2

BAILEY AC ELECTRONIC RECORDER OR INDICATOR

Type WS35 Class JCW Serial No. 100640R
Chart No. 15C6 Indicating Scale Range
Chart Reading X 1= Gallons per Minute
Indicating Scale Reading X
Integrator Reading X
Wall or Panel Mounting Supply Current 115 Volts 60 Cycles

CLASS J TELEMETER RECEIVING UNIT

	Recorder No. 1	Recorder No. 2	Recorder No. 3	Recorder No. 4
Service	1.04 Specific Gravity Fluid Flow			
Pen Color	Red			
Unit Position	3			
Amplifier Pt. No.	661800A1			

CLASS Q RESISTANCE ELEMENT TEMPERATURE UNIT

	Recorder No. 1	Recorder No. 2	Recorder No. 3	Recorder No. 4
Service				
		Class C contact set to make on decreasing flow. Contact to be used with 220V. a-c current.		
Range				
Pen Color				
Unit Position				
Amplifier Pt. No.				
No. Elements in Series				
Resistance Each Element				
Element Pt. No.				
Protecting Well Pt. No.				
Prot. Well Material				

CLASS ~~H C W CH X W~~ RETRANSMITTER

Operating from Pen No. 2
Operating to Pen No. 3 in Meter No. 100639R, on S.O. 228102

CONTROLLER DATA

Piping Diagram
Operated by
Range to
Operating Standard
Calibrated for

An Increase in Increases Decreases Loading Pressure
And

REMARKS This sheet covers receiver only. For transmitter, see Sheet No. 1, S.O. 228101.

(2)

SPECIFICATION SHEET

FLUID METERS AND BOILER METERS

FIRM California Institute of Technology
PLANT
LOCATION Pasadena, California

Date Nov. 12, 1945
Our S. O. No. 228102
Purchase Order No. 17547-S
BY

Sheet No. 1

	BAILEY Tele- METER DATA		DESIGN DATA		
1	Type G-1 Class W		29	To Measure Flow of	Specific Gravity Fluid
2	Serial No. 100639T		30	Maximum Capacity	30 GPM
3	Meter for 1.53 Specific Gravity Fluid		31	Maximum Meter Differential	120 inches of water
			32	STEAM — Pressure	psi. gage
4	Chart No.		35	Superheat F. or Moisture	%
5	Chart Reading		36	Total Temperature	°F.
6	Scale Reading X		39	Specific Volume	cu. ft./lb.
7	Integrator Reading X		40	WATER — Pressure	psi. gage
8	Integrator Gears: Driver Driven		37	Temperature °F., Density	lb./cu. ft.
9	Pen Color			LIQUID OTHER	
				Flowing Conditions	Standard Conditions
10	[illegible] 115 Volts 60 Cycles		38	Pressure 1010 psi	
11	Wall [illegible] Mounted		39	Barometer	
			45	Temperature 70 °F.	°F.
	BOILER OR RATIO METER AIR-FLOW MECHANISM		41	Saturation %	%
12	Air-flow Bells: Rectangular — Part No. 311734C1 Round — Part No. 312083A1		42	[illegible] Dry Basis	
13	Air-flow Displacer: Large — Part No. 311745C2 Small — Part No. 311745C1		43	[illegible] Density	25.5
14	Use Sealing Oil — In A. F. Mechanism		44	Orifice [illegible] Material	Stainless Steel
15	Displacer A.F. Mech. Displacer Small — Part No. 312271B1 Large — Part No. 312271D2		47	Orifice Plate [illegible] Diameter	2.030"
16	Indicating Scale Range:		46	Thickness of Orifice Plate or [illegible]	1/16 Inches
	PRIMARY ELEMENT INSTALLATION DATA		47	Orifice Hole [illegible] Diameter	.917 Inches
17	Serial No. Orifice, [illegible] 72300		48	Ratio, hole or throat to pipe Diameter	.5997
18	Venturi Tube Laying Length		49	Hole Eccentric	Inches
19	Drawing No.		50	Height of Segment	Inches
20	LOCATE in 1-1/2" X.H. Pipe Horiz. flow above meter		51	No. Drain Holes 1 Diam. Drain Hole 3/32	Inches
21	Straight Pipe Inlet		52	Locate Drain Hole at top	of Pipe
22	Preceded by Ell		53	Elevated or Run on Outlet Side	
23	Straight Pipe Outlet Str. Pipe & Reg. Valve		54	No. Centering Pins	Size Centering Pins
24	K1= 3-7/8 Inches. Tap for 1/2" Pipe Thread			Remarks This sheet covers transmitter only. For receiver, see Sheet No. 2, S.O. 228102.	
25	K2= 5/8 Inches. Tap for 1/2" Pipe Thread				
	K1 is connection on inlet side. K2 is on outlet side				
26	Drill K1 and K2 into side of pipe				
27	Inside Pipe Diameter at K1= 1.335 Inches				
28	Inside Pipe Diameter at K2= 1.356 Inches				

AUXILIARY RECORDER DATA			CONTROLLER DATA
Class			Piping Diagram
Service			Operated by
Serial No.			
Range	to	to	Range
Pen Travel	Chart	Chart	Operating Std.
Pen Color			Calibrated for
Position			
Pen Length	Inches	Inches	An Increase in
Capillary Length	Feet	Feet	Increases Decreases Loading Pressure
Bulb Dia. and Material	"—	"—	And
Active Bulb Length			
Bulb Inserted			

SPECIFICATION SHEET

AC ELECTRONIC RECORDER OR INDICATOR

BAILEY METERS

FIRM California Insitututeof Technology
PLANT
LOCATION Pasadena, California

Date Nov. [illegible], 1945
Our S.O. No. 828108
Purchase Order No. 17547-[illegible]
BY

BAILEY AC ELECTRONIC RECORDER OR INDICATOR

Type [illegible]35 Class JAPJCW Serial No. 100639R
Chart No. 30 Indicating Scale Range
Chart Reading X 1 = Gal/min.
Indicating Scale Reading X
Integrator Reading X
Wall or Panel Mounting Supply Current 115 Volts 60 Cycles

CLASS J TELEMETER RECEIVING UNIT

	Recorder No. 1	Recorder No. 2	Recorder No. 3	Recorder No. 4
Service	1.55 Specific Gravity Fluid Flow	Flow Ratio		
Pen Color	Red	Blue		
Unit Position	3	2		
Amplifier Pt. No.	661800A1	661800A1		

CLASS Q RESISTANCE ELEMENT TEMPERATURE UNIT

	Recorder No. 1	Recorder No. 2	Recorder No. 3	Recorder No. 4
Service				
Range				
Pen Color				
Unit Position				
Amplifier Pt. No.				
No. Elements in Series				
Resistance Each Element				
Element Pt. No.				
Protecting Well Pt. No.				
Prot. Well Material				

Type C contact set to make on decreasing flow. Contact to be used with 220V. a-c current

CLASS [illegible] W [illegible] TRANSMITTER

Operating from Pen No. 2
Operating to Pen No. 3 Amplifier No. 100639R (thi[illegible] unit)

CONTROLLER DATA

Piping Diagram D07134
Operated by Flow Ratio
Range 0 to 15 GPM-1.04 Sp. Gr. Fluid; 0 to 30 GPM-1.5[illegible] Sp. [illegible] Fluid
Operating Standard Any ratio up to 3:1
Calibrated for 15# Constant Loading Pressure at Operating Standard

An increase in Flow of 1.52 Sp. Gr. Fluid Increases [illegible] Loading Pressure
And opens valve in 1.04 Sp Gr. Fluid Line.

REMARKS

SPECIFICATION SHEET

SELECTOR VALVES AND MANUAL RELAYS

FIRM California Institute of Technology
PLANT
LOCATION Pasadena, Calif.

Date Nov. 12, 1945
Purchase Order No. 175478
BY

BAILEY SELECTOR VALVES AND MANUAL RELAYS

Control Piping Diagram 50769

1 Type A32-4		Serial No. 190215	S. O. No. 2281105
Service Fuel			
1 Type A32-4		Serial No. 190216	S. O. No. 2281105
Service Oxidizer			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			
Type		Serial No.	S. O. No.
Service			

Remarks

Form No. 201
Printed in U. S. A.

BAILEY METER COMPANY
CLEVELAND, OHIO

SPECIFICATION SHEET

CONTROL VALVES AND FW REGULATORS

FIRM California Institute of Technology
PLANT
LOCATION Pasadena, Calif.

Date Nov. 12, 1945
Our S. O. No. 228104
Purchase Order No. 175475
BY

BAILEY CONTROL VALVE OR FEED WATER REGULATOR

Service	Ratio Control Valve
Type	
Style	V7P2
Class	
Serial No.	H16666
Size	1"
Type Port	713118114
Port Area	.051 sq. in.
Maximum Capacity *	18.2 G.P.M.
Pressure Drop at Maximum Capacity	
Fluid Through Valve	
Fluid Pressure	910 psi
Fluid Temperature	70° F
Valve Pressure Standard	1,500#
Valve Body Material	Cast Steel
Inner Valve Material	Stainless Steel Stellited
Valve Travel	3/4"
Valve Spring Part No.	0001

For Diaphragm-Operated or Piston-Operated Control Valve:

Piping Diagram	507164
Valve Closes for	decrease in Air Pressure
Control Pressure Range	35 to 5 psi
Diaphragm Style	2A
Piston Operated Valve Body Assembly Drawing No.	
Piston Operator Assembly Drawing No.	

For Thermo-Hydraulic Feed Water Regulators or Direct-action Valves:

Steam Pressure	
Generator Assembly Drawing No.	
Stem and Disc Assembly Part No.	
Cage Assembly Part No.	
Valve Assembly Drawing No.	

Remarks:

BAILEY METER COMPANY
CLEVELAND, OHIO

SPECIFICATION SHEET

PRESSURE, TEMPERATURE RECORDERS OR INDICATORS

FIRM California Institute of Technology
PLANT
LOCATION Pasadena 4, Calif.

Date Nov. 12, 1945
Our S. O. No. 225105
Purchase Order No 125473
BY

BAILEY RECORDER, INDICATOR, RECORDER-CONTROLLER OR INDICATOR-CONTROLLER

Type M56 Class S-SAP
Serial No. 107310 Chart No. 50006
Electric Chart Drive 110 Volts 60 Cycles
Panel Mounting

Recorder	Recorder No. 1	Recorder No. 2	Recorder No. 3	Recorder No. 4
Service	Pressure in Vessel	Controls Pressure in Vessel		
Class	S	S.P		
Serial No.	31758	31759		
Range	0 to 500#	0 to 500#	to	to
Pen Travel	Full Chart	Full Chart	Chart	Chart
Position	0-2-2	Control		
Pen Color	Red			
Capillary Length	Feet	Feet	Feet	Feet
Active Bulb Length				
Bulb Diameter	Inches	Inches	Inches	Inches
Bulb Material				
Type Separable Socket				
Mat'l Separable Socket				
Bulb Inserted				

CONTROLLER DATA

Piping Diagram 507/64
Operated by Pressure
Range 0 to 500#
Operating Standard 420#
Calibrated for 15 (pen contact with pen (or pointer) and standard pointer together)
An Increase in Pressure (Decrease Implies Decrease Pressure)
And Norgren 1-1/2" Valve in 1.84 sq. cm. fluid line

Remarks:

Form No. 216
Printed in U. S. A.

BAILEY METER COMPANY
CLEVELAND, OHIO

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SPECIFICATION SHEET

INDUSTRIAL VALVES AND FW REGULATORS

FIRM California Institute of Technology
PLANT
LOCATION Pasadena, Calif.

Date Nov. 12, 1945
Our S. O. No. 825106
Purchase Order No. 175475
BY

BAILEY CONTROL VALVE OR FEED WATER REGULATOR

Service	Pressure Control Valve
Type	
Style	1895
Class	9
Serial No.	#16667
Size	1-1/2"
Type Port	713118A15
Port Area	.027 sq. in.
Maximum Capacity	26.6 G.P.M.
Pressure Drop at Maximum Capacity	
Fluid Through Valve	Pressure
Fluid Pressure	560#
Fluid Temperature	70° F
Valve Pressure Standard	1,500#
Valve Body Material	Stainless steel
Inner Valve Material	Stainless Steel Stellited all over
Valve Travel	5/4"
Valve Seating Part No.	0001

For Diaphragm-Operated or Piston-Operated Control Valve:

Piping Diagram	507164
Valve Closes for	Increase to air Pressure
Control Pressure Range	25 to 5 psi
Diaphragm Style	DP
Piston Operated Valve Body Assembly Drawing No.	
Piston Operator Assembly Drawing No.	

For Thermo-Hydraulic Feed Water Regulators or Direct-acting Valves:

Steam Pressure	
Generator Assembly Drawing No.	
Stem and Disc Assembly Part No.	
Cage Assembly Part No.	
Valve Assembly Drawing No.	

Remarks:

Form No. 247

Printed in U. S. A.

BAILEY METER COMPANY
CLEVELAND, OHIO

8

INSTRUCTIONS

SECTION M 10-A

FOR INSTALLATION OF ORIFICES AND FLOW NOZZLES

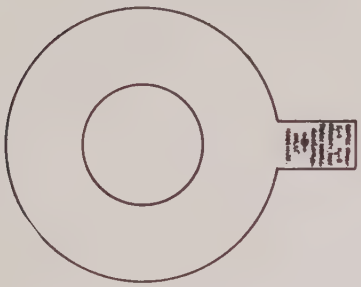
FOR

BAILEY METERS

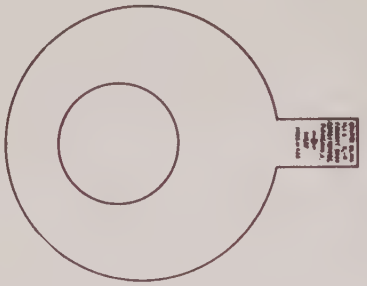
MEASURING FLOW OF STEAM, LIQUIDS, AIR AND GASES

BAILEY METER COMPANY

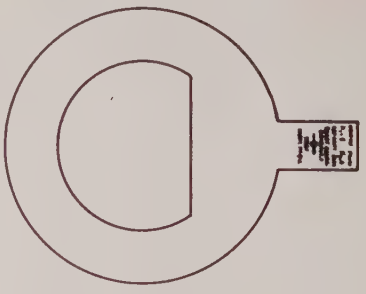
CLEVELAND 10, OHIO



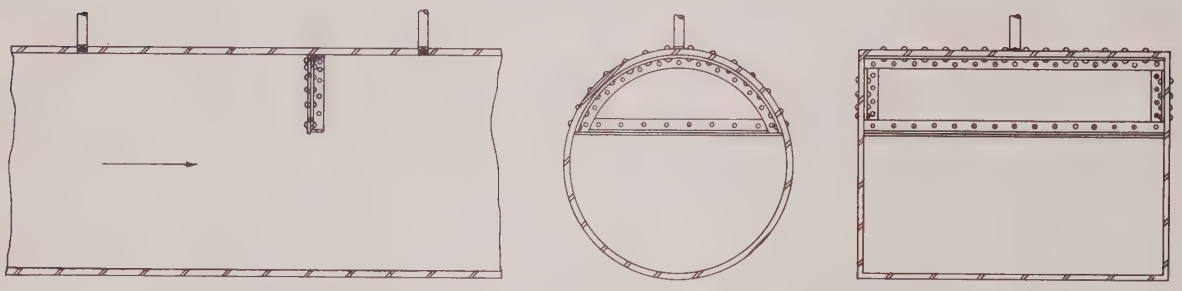
Concentric Orifice



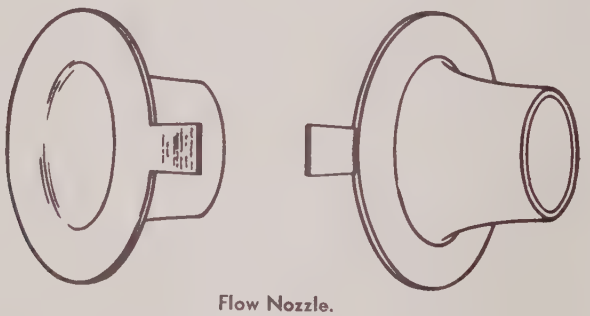
Eccentric Orifice



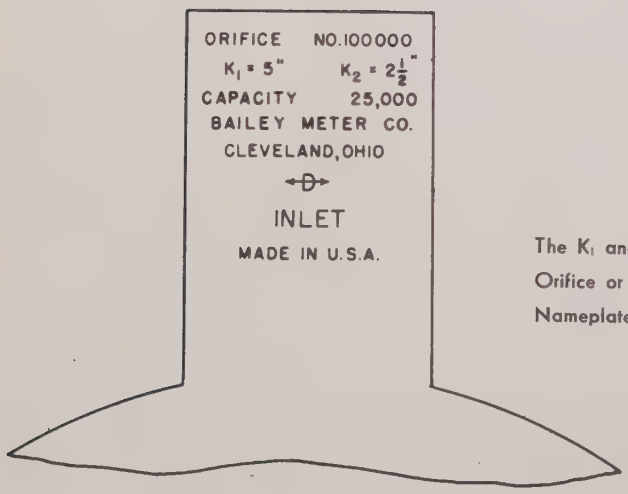
Segmental Orifice



Orifice Segment furnished for air or gas lines measuring several feet in diameter.



Flow Nozzle.



Orifice or Flow Nozzle Nameplate.

The K_1 and K_2 Connection Distance Dimensions for each Flange Type Orifice or Flow Nozzle may be found on the Orifice or Flow Nozzle Nameplate.

FIGURE 1 — Bailey Meter Orifices and Flow Nozzles.

SEQUENCE OF OPERATIONS

(See Following Text for Complete Details)

LOCATION

(See Page 4 for details)

Locate the Orifice or Flow Nozzle between flanges which are preceded and followed by adequate lengths of straight pipe — see Figures 2, 3, 4 and 5.

Locate the K_1 and K_2 pressure connections as designated on the Specification Sheet or on the Orifice or Flow Nozzle Nameplate for each Orifice or Flow Nozzle included in this Book.

CONNECTING NIPPLE INSTALLATION

(See Page 4 for details)

Drill the pipe for the K_1 and K_2 connecting nipples in accordance with the size as given in detail for steam, water, air, gases and non-condensible vapors in this Instruction Section.

Completely remove all burrs caused by drilling the pipe. Measure accurately the internal pipe diameters at K_1 and K_2.

Install the K_1 and K_2 connecting nipples, making sure they do not project inside the pipe; also that they are level lengthwise and with each other.

Bent nipples, also straight vertical nipples, must be adequately lagged.

ORIFICE OR FLOW NOZZLE INSTALLATION

(See Page 9 for details)

Nameplate must be in line with K_1 and K_2 nipples, with Nameplate stamping on ***inlet*** side.

Centering Pins, if used, must fit snugly inside the pipe on inlet side. Bevelling of Orifice hole, if used, must be on the outlet side.

Orifice or Flow Nozzle flange must be centered up with pipe on inlet side.

Suitable gaskets must be used on both faces of Orifice or Flow Nozzle flange. Be sure gaskets do not project inside pipe.

VALVES

(See Page 17 for details)

All valves must close against the main line pressure.

RESERVOIRS

(See Page 17 for details)

Reservoirs for steam and for hot water must be installed level lengthwise and with each other.

Adequate supports for these reservoirs must be provided.

INSTRUCTIONS FOR THE INSTALLATION OF ORIFICES AND FLOW NOZZLES

FOR BAILEY METERS MEASURING FLOW OF STEAM, LIQUIDS, AIR AND GASES

The location and other pertinent information concerning this Orifice or Nozzle may be found on the Specification sheet enclosed in this Instruction Book.

LOCATION

Since certain arrangements of piping are known to set up disturbances in the flow which make accurate metering impossible, it is essential that the Orifice or Flow Nozzle be placed in a location approved by the Bailey Meter Company. Location of the Orifice or Flow Nozzle depends upon the minimum required length of straight pipe preceding and following the installation to result in accurate metering. Schedules 1 through 8 in Figure 2 show the standard requirements. Inasmuch as these are not sufficiently complete and precise in themselves, Figures 3, 4 and 5 illustrate diagrammatically the application of these standards to a number of typical piping layouts commonly encountered in actual practice. If none of the diagrammatics fit the installation in question, we strongly recommend that our Engineering Department be consulted.

Another precaution to be taken in the installation of the Primary Element is to locate it where the fluid is cleanest and where it is free from pulsations. Pulsating flow requires special treatment; please notify us if this condition possibly exists in this installation.

In pipes where scale, sediment, tarry substances, or other foreign matter accumulates on the inside of the pipe at the point of Orifice or Nozzle installation, make arrangements for periodically cleaning and draining out these accumulations. These substances collecting in the pipe change the effective area and, therefore, cause inaccuracy in the metering. It is always best to select a location where the fluid is clean and thus avoid this trouble.

STRAIGHTENING VANES

In cases where it is absolutely impossible to install an Orifice or Flow Nozzle where there is the required length of straight pipe (see the section entitled "Location" and Figures 2, 3, 4 and 5), a straightening vane may be used. Straightening vanes should be used only as a last resort inasmuch as providing the correct length of straight pipe is the best way of obtaining a satisfactory metering installation.

Figure 17 shows a straightening vane of the flanged type. The vane is placed inside the pipe and the vane flange is clamped between pipe flanges in the same manner as an Orifice. Although it is not always possible, it is recommended that the straightening vane extend upstream in the pipe from the vane flange. Straightening vanes of the welded-in type is used, a drawing in this Instruction Book will show the method of installation.

K_1 AND K_2 CONNECTING NIPPLES

The Specification Sheet covering details of the design of each Orifice or Flow Nozzle shows the K_1 and K_2 distances for that Orifice or Nozzle. The Orifice or Flow Nozzle nameplate also shows K_1 and K_2 distances. The K_1 distance is measured from the inlet face of the Orifice or Flow Nozzle to the center of the nipple on the inlet side, or the K_1 connecting nipple. The K_2 distance is measured from the inlet face of the Orifice or Flow Nozzle to the center of the nipple on the outlet side, or the K_2 connecting nipple. The lower sketch of Figure 6 illustrates these measurements.

SIZE OF CONNECTIONS

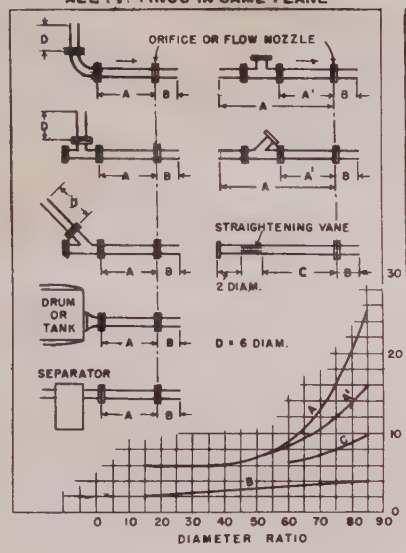
Various services require different kinds and sizes of connecting nipples, and consequently different size holes in the pipe. These sizes are as follows:

Steam

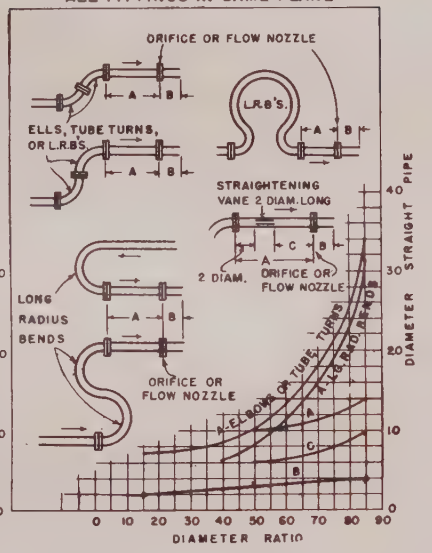
In horizontal steam flow installation, ½″ pipe size steel K_1 and K_2 connecting nipples are used for pressure from 25 to 900 psi and temperatures up to 750° F. These connections are always placed in the side of the pipe, except when the Orifice or Flow Nozzle immediately follows a bend in a horizontal plane, in which case the connections are placed on top of the pipe as shown in Figure 7. ¾″ nipples are used on top of pipes following a bend in a horizontal plane.

For vertical steam lines, it is essential that the lower connecting nipple be bent and so placed as to bring both reservoirs to the same level. Figure 8 illustrates an Orifice or Flow Nozzle installation in a vertical steam line where the flow is down. Note the K_2 nipple is bent up to bring the lower reservoir connections level with the upper. Figure 9 shows the same type of installation for the flow going up; in this instance, the K_1 is the bent nipple.

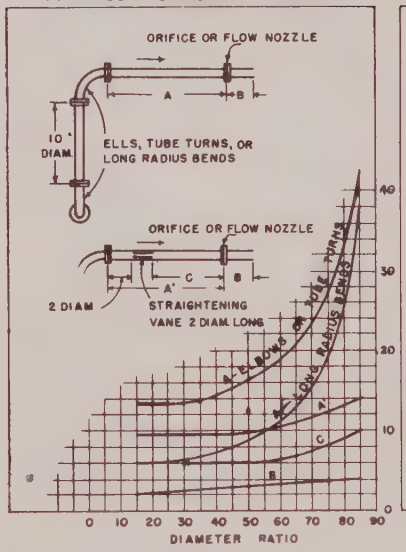
SCHEDULE 1
FOR ORIFICES AND FLOW NOZZLES
ALL FITTINGS IN SAME PLANE



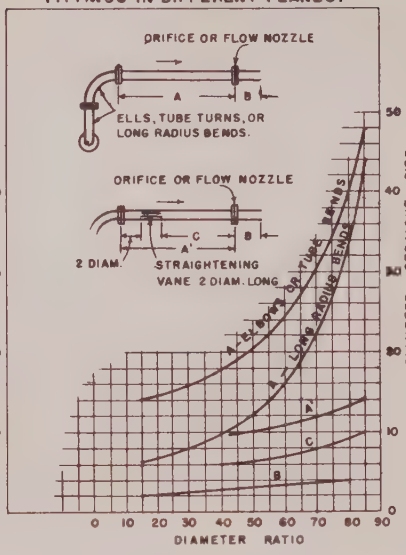
SCHEDULE 2
FOR ORIFICES AND FLOW NOZZLES
ALL FITTINGS IN SAME PLANE



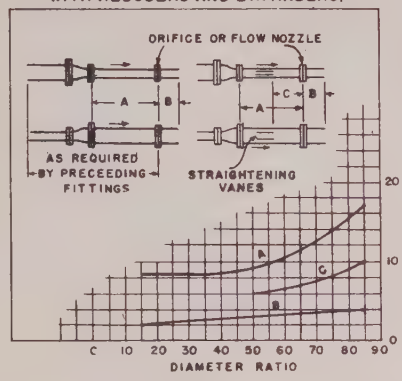
SCHEDULE 3
FOR ORIFICES AND FLOW NOZZLES
FITTINGS IN DIFFERENT PLANES



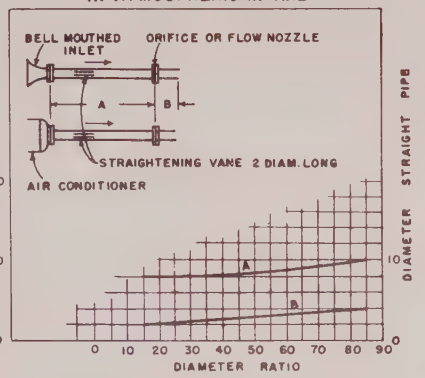
SCHEDULE 4
FOR ORIFICES AND FLOW NOZZLES
FITTINGS IN DIFFERENT PLANES.



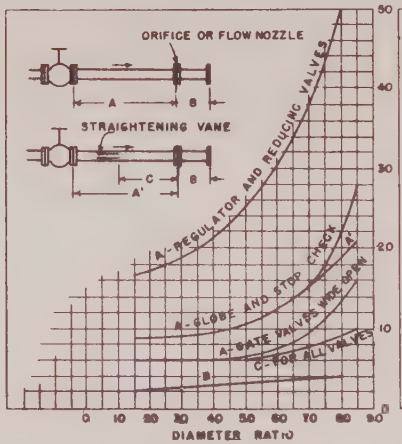
SCHEDULE 5
FOR ORIFICES AND FLOW NOZZLES
WITH REDUCERS AND EXPANDERS.



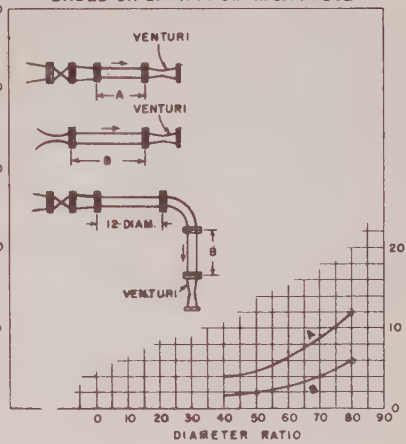
SCHEDULE 6
FOR ORIFICES AND FLOW NOZZLES
IN ATMOSPHERIC INTAKE



SCHEDULE 7
VALVES



SCHEDULE 8
FOR VENTURI TUBES
BASED ON DATA FROM W. S. PARDOE



	.0 – .50 RATIO	.50 – .60 RATIO	.60 - .70 RATIO	.70 - .80 RATIO
FITTINGS ALLOWED ON OUTLET SIDE IN PLACE OF STRAIGHT PIPE.	1. TEES 2. 45 ELLS 3. GATE VALVES 4. SEPARATORS 5. Y-FITTINGS 6. EXPANSION JTS.	1. TEES 2. EXPANSION JTS 3. GATE VALVES 4. Y-FITTINGS 5. SEPARATOR (IF INLET NECK IS ONE DIAM. LG.)	1. GATE VALVES 2. Y-FITTINGS 3. SEPARTOR (IF INLET NECK IS ONE DIAM. LONG)	1. GATE VALVE 2. LONG RADIUS BEND

FIGURE 2 — Piping Requirements for Orifices, Flow Nozzles and Venturi Tubes.

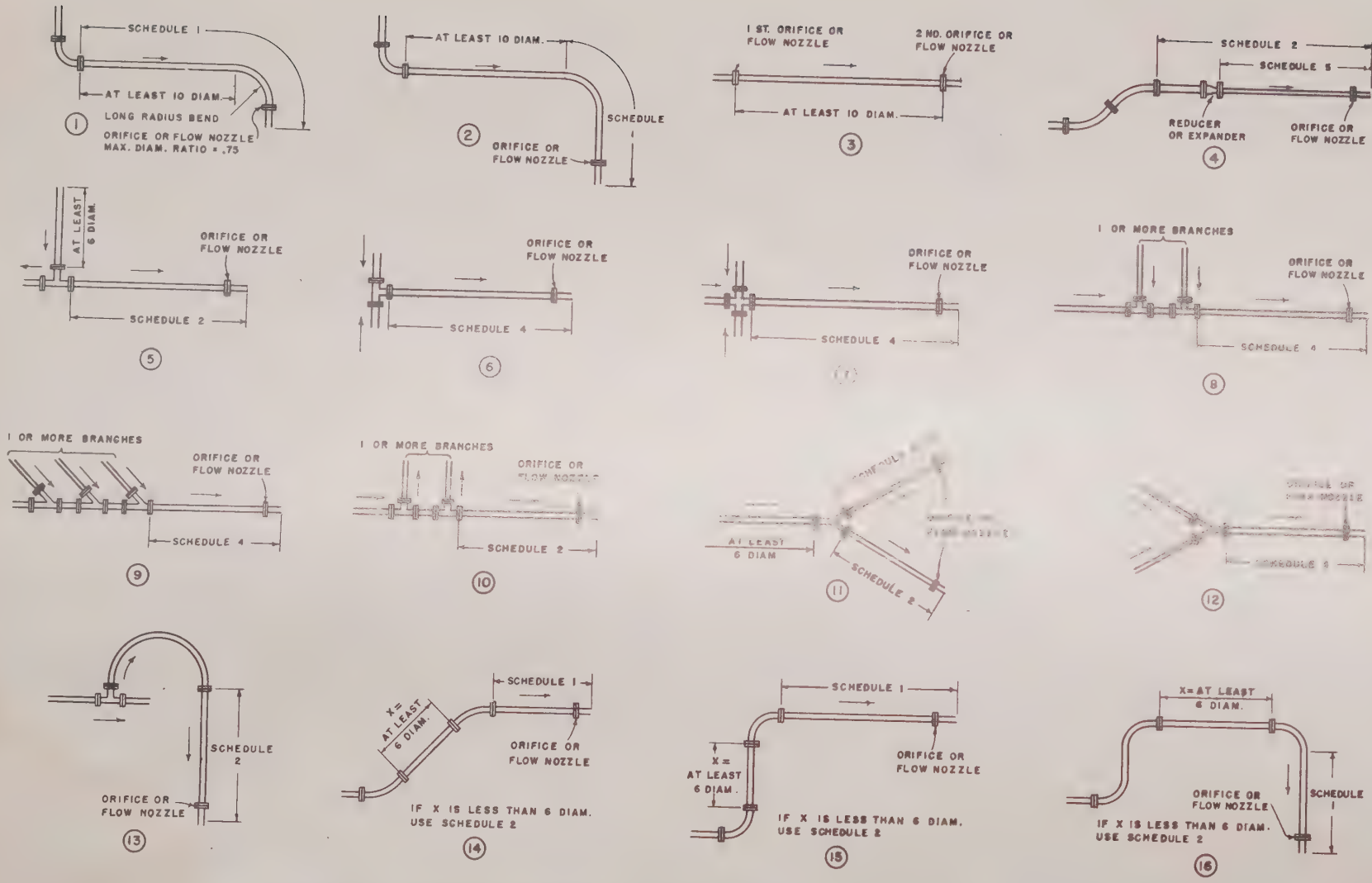


FIGURE 3 — Typical Piping Arrangements with Fittings or Bends in Same Plane. Refer to Figure 2 for Schedule Specifications.

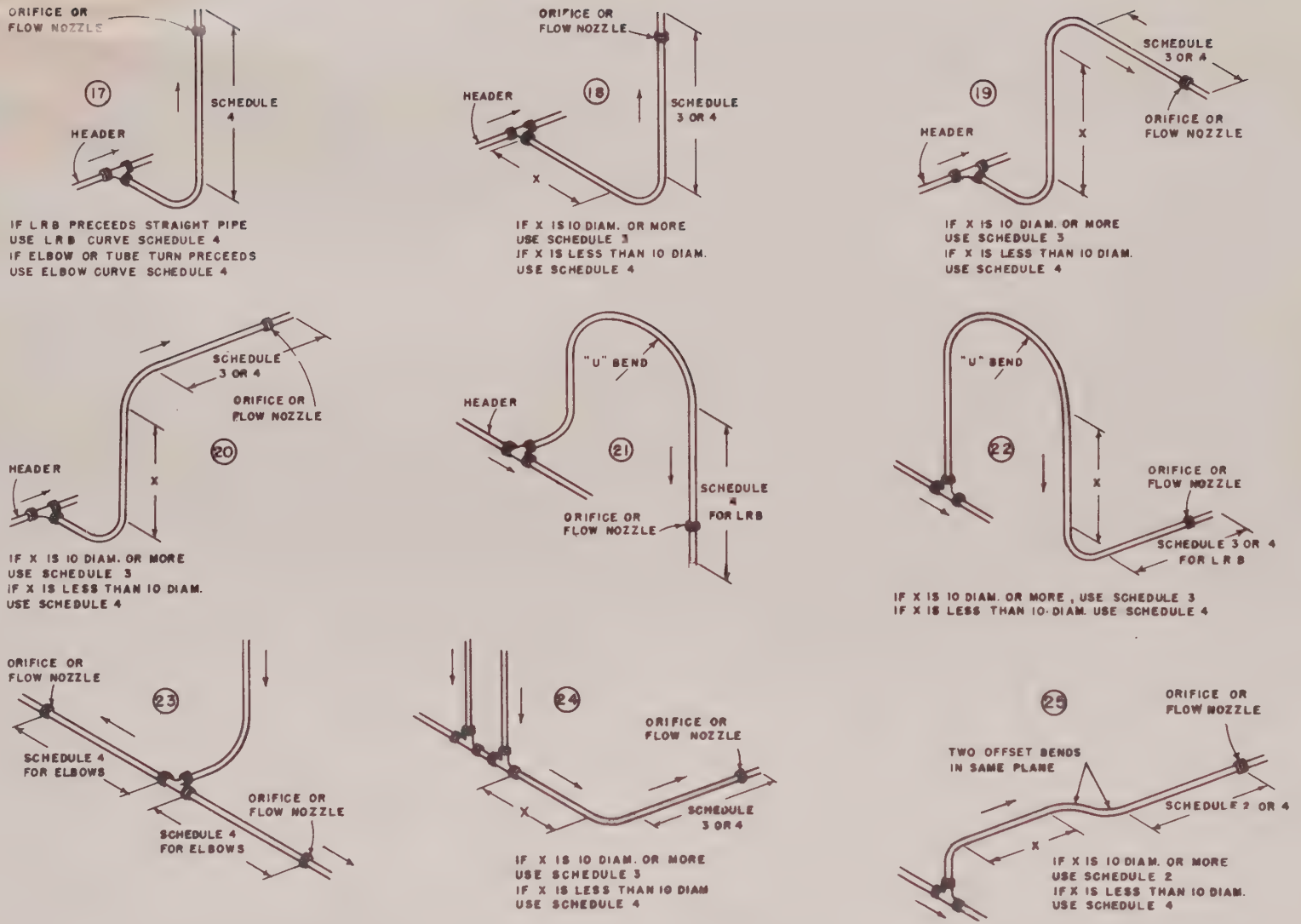

ORIFICE OR FLOW NOZZLE
17
SCHEDULE 4
HEADER
IF L R B PRECEEDS STRAIGHT PIPE USE L R B CURVE SCHEDULE 4
IF ELBOW OR TUBE TURN PRECEEDS USE ELBOW CURVE SCHEDULE 4
ORIFICE OR FLOW NOZZLE
HEADER
18
SCHEDULE 3 OR 4
X
IF X IS 10 DIAM. OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM. USE SCHEDULE 4
SCHEDULE 3 OR 4
19
HEADER
X
ORIFICE OR FLOW NOZZLE
IF X IS 10 DIAM. OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM. USE SCHEDULE 4
SCHEDULE 3 OR 4
ORIFICE OR FLOW NOZZLE
20
HEADER
X
IF X IS 10 DIAM. OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM. USE SCHEDULE 4
"U" BEND
HEADER
21
SCHEDULE 4 FOR L R B
ORIFICE OR FLOW NOZZLE
"U" BEND
22
X
ORIFICE OR FLOW NOZZLE
SCHEDULE 3 OR 4 FOR L R B
IF X IS 10 DIAM. OR MORE , USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM. USE SCHEDULE 4
ORIFICE OR FLOW NOZZLE
23
SCHEDULE 4 FOR ELBOWS
ORIFICE OR FLOW NOZZLE
SCHEDULE 4 FOR ELBOWS
24
ORIFICE OR FLOW NOZZLE
X
SCHEDULE 3 OR 4
IF X IS 10 DIAM. OR MORE USE SCHEDULE 3
IF X IS LESS THAN 10 DIAM USE SCHEDULE 4
25
ORIFICE OR FLOW NOZZLE
TWO OFFSET BENDS IN SAME PLANE
SCHEDULE 2 OR 4
X
IF X IS 10 DIAM. OR MORE USE SCHEDULE 2
IF X IS LESS THAN 10 DIAM. USE SCHEDULE 4

FIGURE 4 — Typical Piping Arrangements with Fittings and Bends not in Same Plane. Refer to Figure 2 for Schedule Specifications.

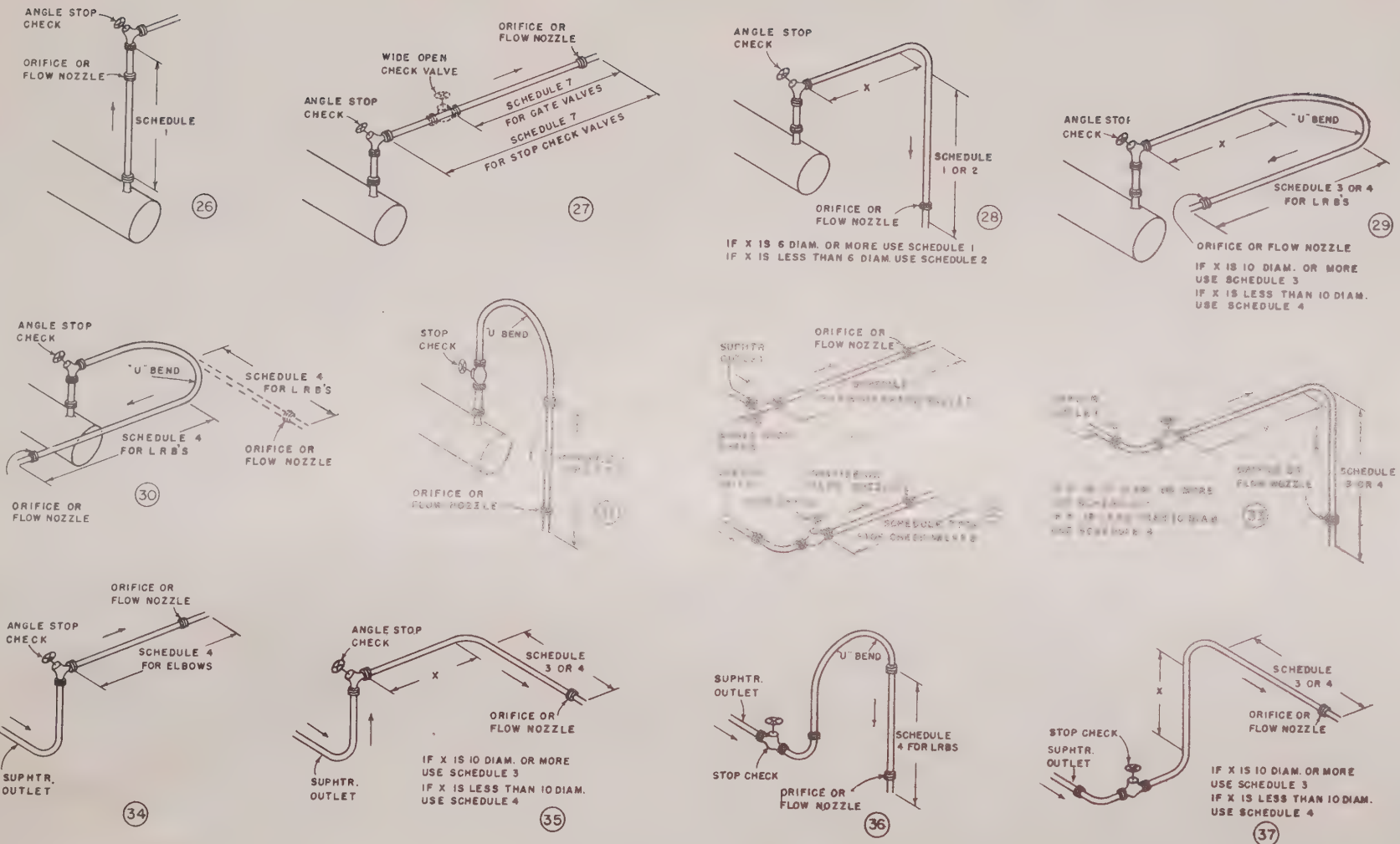


FIGURE 5 — Typical Boiler Outlet Arrangements. Refer to Figure 2 for Schedule Specifications.

It will be noted that the bent steel nipple is ¾" pipe size.

Low pressure installations, where the operating pressure is less than 25 psi, require the use of 1" screwed steel connecting nipples in all cases regardless of whether the flow is horizontal or vertical.

For pressures above 900 psi and for temperatures about 750° F., the K_1 and K_2 nipples are usually made 1" pipe size and of carbon molybdenum steel welded to the pipe instead of screwed.

In all installations where the steam temperature is at least 750° F., the connecting nipples and the valve bodies which follow the nipples should be lagged.

Water and Liquids

In measuring the flow of water and of most liquids in a horizontal line, ⅜" pipe size brass K_1 and K_2 connecting nipples are used when the temperature is below 250° F. and the pressure is not in excess of 350 psi. For pressures from 350 to 900 psi, when the temperature is below 250° F., ⅜" pipe size steel connecting nipples are used. This type of installation is shown in Figure 10. For temperatures of 250° F. and above, ½" steel connecting nipples are used. These connections are always placed on the ***side*** of the pipes as shown in Figure 6.

For vertical Flow Nozzle installations below 250° F., ⅜" brass nipples are used. At 250° F. and above, however, the upper connection is a ¾" pipe size steel nipple, and the lower connection is a ½" pipe size steel nipple, as shown in Figure 11, regardless of whether the flow is up or down. It will be noted from this drawing that the upper nipple is bent to bring both reservoirs level with each other.

At pressures above 900 psi, with temperatures above 250° F., 1" pipe size steel nipples are used, and must be welded to the pipe.

In the event that the liquid being measured is corrosive to brass or steel, stainless steel nipples of the same size and type as above are used.

Air, Gases and Non-Condensible Vapors

Use ½" pipe size steel nipples installed in the ***top*** of the pipe, as shown in Figure 12.

GENERAL RULES FOR NIPPLE INSTALLATION

In all cases, both connections must be made in the same side of the pipe and on the same axial center line, unless specific directions have been given to the contrary.

The holes for the connections at K_1 and K_2 must be spotted and drilled accurately to within $\frac{1}{16}$" of the dimensions specified. Guide the drill and tap on a line through the center of the pipe horizontally when the nipples are to be installed on the side of the pipe or vertically when the nipples are to be installed on the top of the pipe.

IMPORTANT. Care must be taken that all burrs caused by the drilling are removed completely from the inside of the pipe. The inside edge of the holes at K_1 and K_2 should be sharp or only slightly rounded.

After removing the burrs, measure the internal diameter of the pipe at K_1 and K_2 in three or four positions around the pipe. If the diameters do not check those given on the Specification Sheet, please notify our Engineering Department so that the proper correction factors may be furnished.

In cases where it is found necessary or advisable to weld bosses or half couplings on the pipe to take the nipples, as shown in Figure 13, it is essential that the inside pipe surface be made perfectly straight and smooth after welding. Any obstructions at these connections cause pressure differentials not in accord with the design of the element Lumps of metal around the holes in the pipe line have an effect similar to that of screwing the nipples in too deeply.

Nipples must not project inside the pipe, but must be flush with the inside of the pipe. They must be installed so as to be level not only lengthwise but also with each other.

Nipples furnished by Bailey Meter Company have a circumferential groove cut in exactly 1" from the end. This groove serves as a reference point to gage the depth of the nipple in the pipe. When these nipples are screwed into the pipe to make a pressure tight connection, the distance from the groove to the outside of the pipe plus the thickness of the pipe wall, must total ***one-inch,*** never less.

All bent nipples and vertical straight nipples must be adequately lagged after installation, as indicated on the drawings. It is also necessary to lag that portion of the connecting tubing between the K_1 and K_2 connections in vertical water lines as shown in Figure 10 when the temperature of the fluid is from 125° F. to 250° F. Horizontal straight nipples should not be lagged.

INSTALLING THE ORIFICE OR NOZZLE

The Orifice or Nozzle must be carefully installed with the nameplate in line with the connections at K_1 and K_2. ***This is most important.*** The drain hole (if any) should be at the bottom of

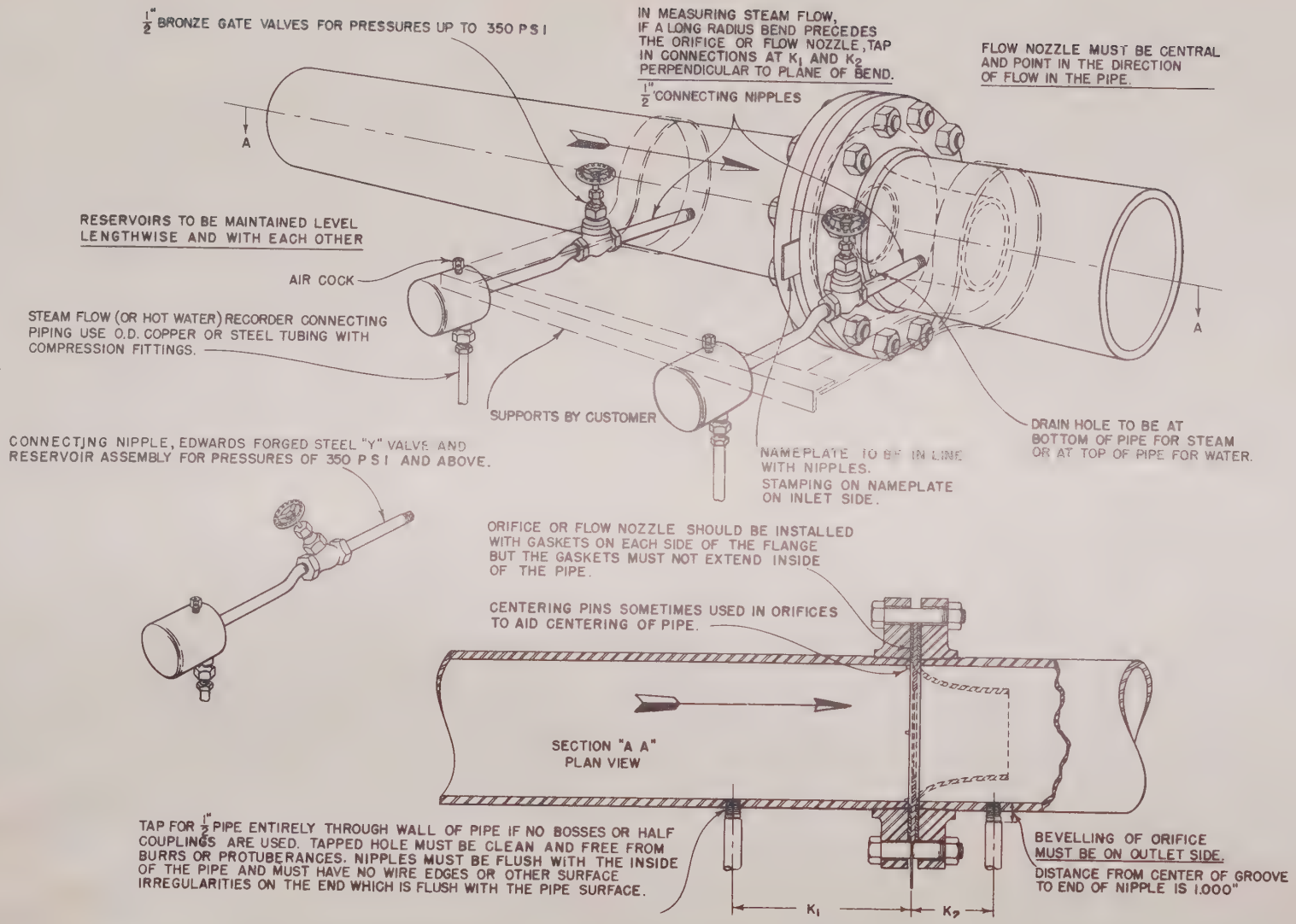

½" BRONZE GATE VALVES FOR PRESSURES UP TO 350 PSI
IN MEASURING STEAM FLOW, IF A LONG RADIUS BEND PRECEDES THE ORIFICE OR FLOW NOZZLE, TAP IN CONNECTIONS AT K1 AND K2, PERPENDICULAR TO PLANE OF BEND.
½" CONNECTING NIPPLES
FLOW NOZZLE MUST BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN THE PIPE.
A
RESERVOIRS TO BE MAINTAINED LEVEL LENGTHWISE AND WITH EACH OTHER
AIR COCK
STEAM FLOW (OR HOT WATER) RECORDER CONNECTING PIPING USE O.D. COPPER OR STEEL TUBING WITH COMPRESSION FITTINGS.
SUPPORTS BY CUSTOMER
NAMEPLATE TO BE IN LINE WITH NIPPLES. STAMPING ON NAMEPLATE ON INLET SIDE.
DRAIN HOLE TO BE AT BOTTOM OF PIPE FOR STEAM OR AT TOP OF PIPE FOR WATER.
CONNECTING NIPPLE, EDWARDS FORGED STEEL "Y" VALVE AND RESERVOIR ASSEMBLY FOR PRESSURES OF 350 PSI AND ABOVE.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE BUT THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
CENTERING PINS SOMETIMES USED IN ORIFICES TO AID CENTERING OF PIPE.
SECTION "A A" PLAN VIEW
TAP FOR ½" PIPE ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLE MUST BE CLEAN AND FREE FROM BURRS OR PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE.
BEVELLING OF ORIFICE MUST BE ON OUTLET SIDE.
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
K1
K2

FIGURE 6 — Installation of Orifice or Flow Nozzle, Nipples, Valves, and Reservoirs in Horizontal Line. (A) For metering flow of steam for pressures not exceeding 900 psi and for temperatures up to 750° F. (B) Also for metering flow of water in horizontal line when temperatures are 250° F. and above.

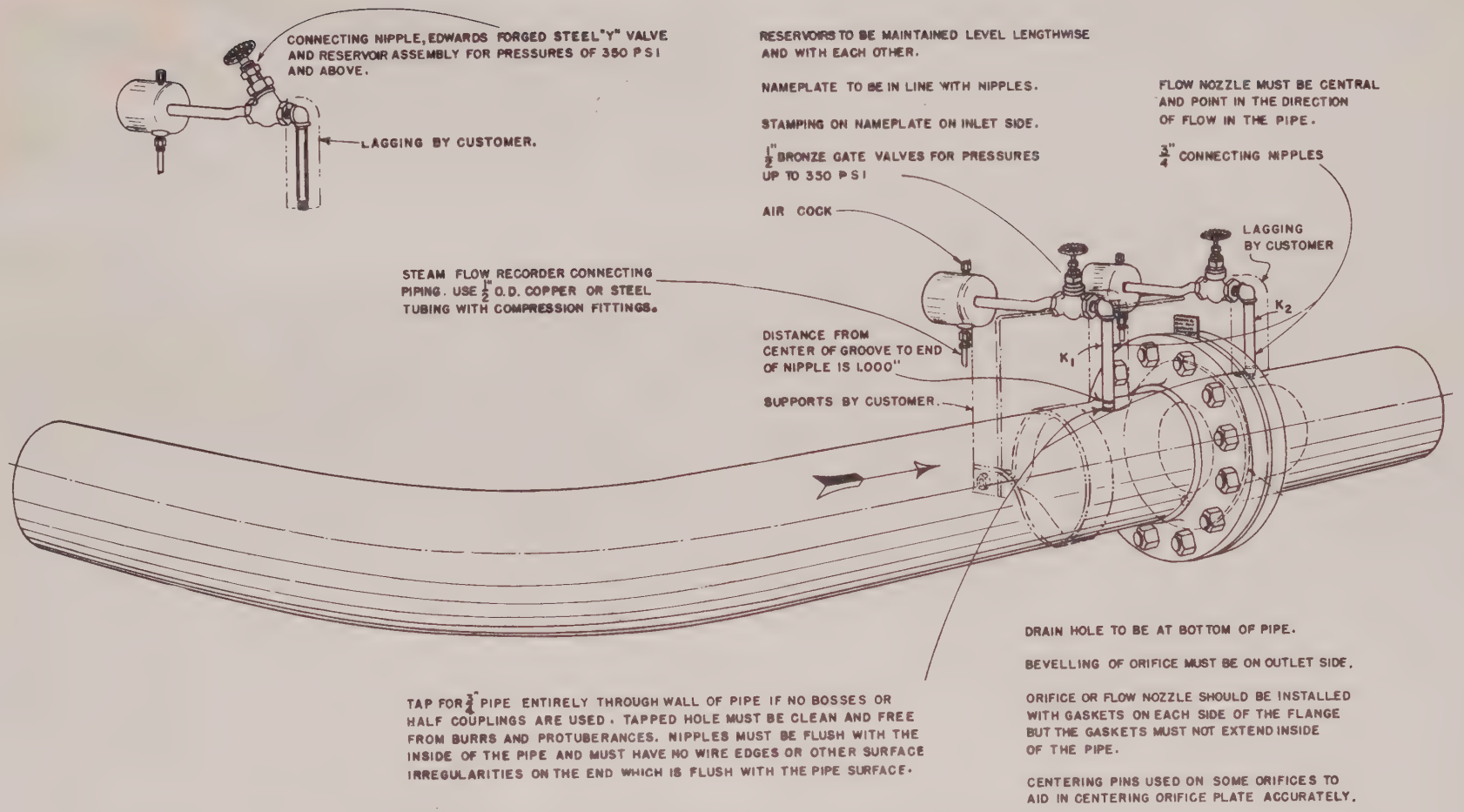

CONNECTING NIPPLE, EDWARDS FORGED STEEL "Y" VALVE AND RESERVOIR ASSEMBLY FOR PRESSURES OF 350 PSI AND ABOVE.
LAGGING BY CUSTOMER.
RESERVOIRS TO BE MAINTAINED LEVEL LENGTHWISE AND WITH EACH OTHER.
NAMEPLATE TO BE IN LINE WITH NIPPLES.
STAMPING ON NAMEPLATE ON INLET SIDE.
½" BRONZE GATE VALVES FOR PRESSURES UP TO 350 PSI
AIR COCK
STEAM FLOW RECORDER CONNECTING PIPING. USE ½" O.D. COPPER OR STEEL TUBING WITH COMPRESSION FITTINGS.
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
SUPPORTS BY CUSTOMER.
FLOW NOZZLE MUST BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN THE PIPE.
¾" CONNECTING NIPPLES
LAGGING BY CUSTOMER
K_2
K_1
TAP FOR ¾" PIPE ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLE MUST BE CLEAN AND FREE FROM BURRS AND PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE.
DRAIN HOLE TO BE AT BOTTOM OF PIPE.
BEVELLING OF ORIFICE MUST BE ON OUTLET SIDE.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE BUT THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
CENTERING PINS USED ON SOME ORIFICES TO AID IN CENTERING ORIFICE PLATE ACCURATELY.

FIGURE 7 — Installation of Orifice or Flow Nozzle, Nipples, Valves, and Reservoirs for metering flow of steam when there is a long radius bend in horizontal plane immediately preceding. For pressures not exceeding 900 psi and for temperatures up to 750° F.

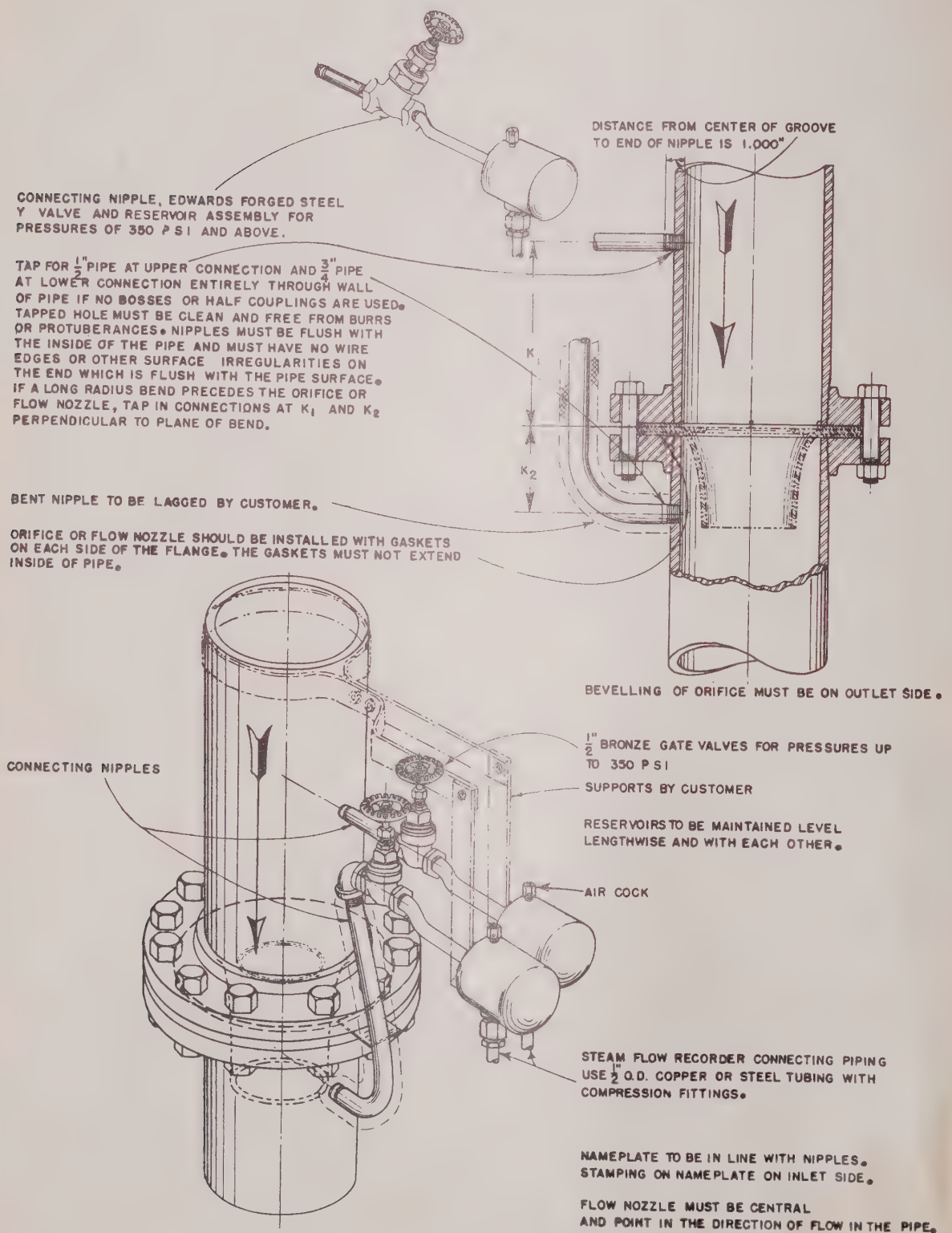

CONNECTING NIPPLE, EDWARDS FORGED STEEL Y VALVE AND RESERVOIR ASSEMBLY FOR PRESSURES OF 350 P S I AND ABOVE.
TAP FOR 1/2" PIPE AT UPPER CONNECTION AND 3/4" PIPE AT LOWER CONNECTION ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLE MUST BE CLEAN AND FREE FROM BURRS OR PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE. IF A LONG RADIUS BEND PRECEDES THE ORIFICE OR FLOW NOZZLE, TAP IN CONNECTIONS AT K1 AND K2 PERPENDICULAR TO PLANE OF BEND.
BENT NIPPLE TO BE LAGGED BY CUSTOMER.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE. THE GASKETS MUST NOT EXTEND INSIDE OF PIPE.
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
K1
K2
BEVELLING OF ORIFICE MUST BE ON OUTLET SIDE.
CONNECTING NIPPLES
1/2" BRONZE GATE VALVES FOR PRESSURES UP TO 350 P S I
SUPPORTS BY CUSTOMER
RESERVOIRS TO BE MAINTAINED LEVEL LENGTHWISE AND WITH EACH OTHER.
AIR COCK
STEAM FLOW RECORDER CONNECTING PIPING USE 1/2" O.D. COPPER OR STEEL TUBING WITH COMPRESSION FITTINGS.
NAMEPLATE TO BE IN LINE WITH NIPPLES. STAMPING ON NAMEPLATE ON INLET SIDE.
FLOW NOZZLE MUST BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN THE PIPE.

FIGURE 8 — Installation of Orifice or Flow Nozzle, Nipples, Valves, and Reservoirs for metering flow of steam vertically downward for pressures not exceeding 900 psi and for temperatures up to 750° F.

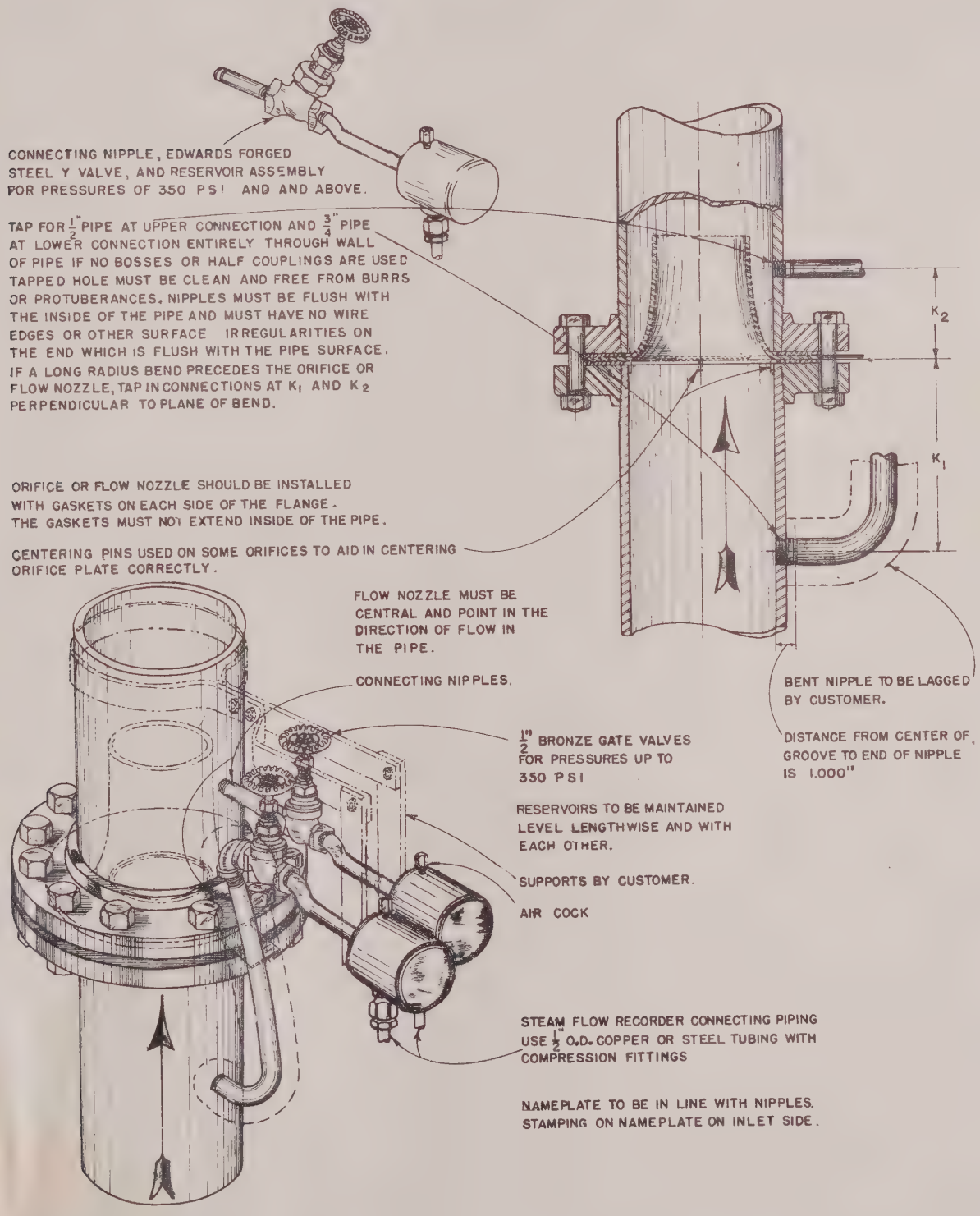

CONNECTING NIPPLE, EDWARDS FORGED STEEL Y VALVE, AND RESERVOIR ASSEMBLY FOR PRESSURES OF 350 PSI AND AND ABOVE.
TAP FOR 1/2" PIPE AT UPPER CONNECTION AND 3/4" PIPE AT LOWER CONNECTION ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED TAPPED HOLE MUST BE CLEAN AND FREE FROM BURRS OR PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE. IF A LONG RADIUS BEND PRECEDES THE ORIFICE OR FLOW NOZZLE, TAP IN CONNECTIONS AT K1 AND K2 PERPENDICULAR TO PLANE OF BEND.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE. THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
CENTERING PINS USED ON SOME ORIFICES TO AID IN CENTERING ORIFICE PLATE CORRECTLY.
FLOW NOZZLE MUST BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN THE PIPE.
CONNECTING NIPPLES.
1/2" BRONZE GATE VALVES FOR PRESSURES UP TO 350 PSI
RESERVOIRS TO BE MAINTAINED LEVEL LENGTHWISE AND WITH EACH OTHER.
SUPPORTS BY CUSTOMER.
AIR COCK
STEAM FLOW RECORDER CONNECTING PIPING USE 1/2" O.D. COPPER OR STEEL TUBING WITH COMPRESSION FITTINGS
NAMEPLATE TO BE IN LINE WITH NIPPLES. STAMPING ON NAMEPLATE ON INLET SIDE.
K2
K1
BENT NIPPLE TO BE LAGGED BY CUSTOMER.
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"

FIGURE 9 — Installation of Orifice or Flow Nozzle, Nipples, Valves, and Reservoirs for metering flow of steam vertically upward for pressures not exceeding 900 psi and for temperatures up to 750° F.

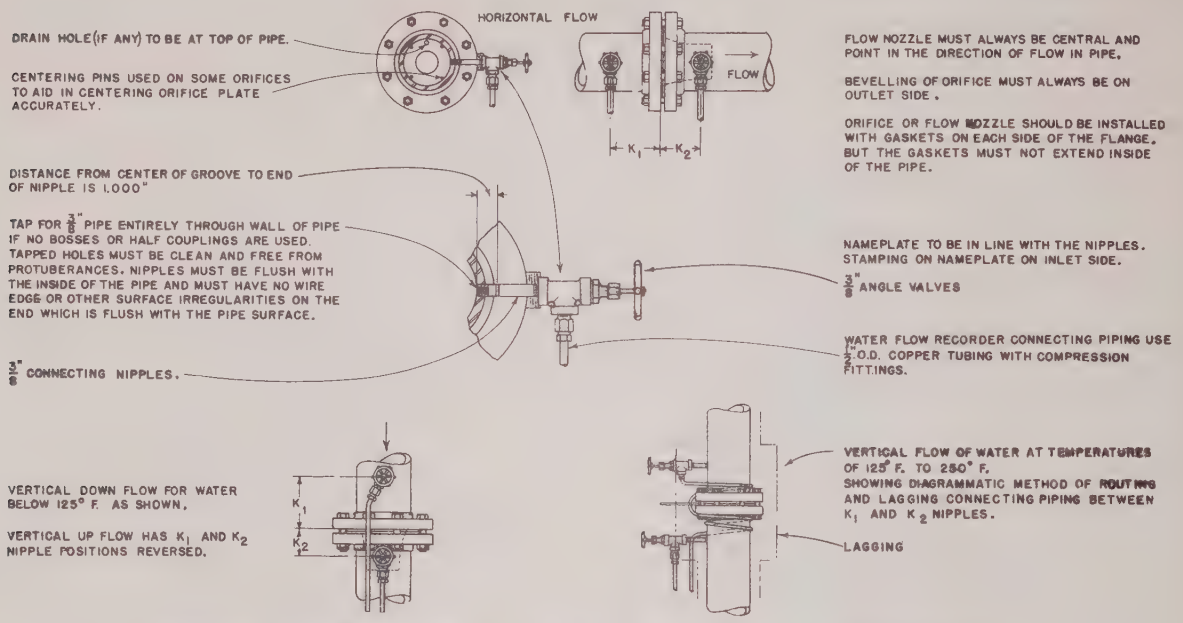

HORIZONTAL FLOW
DRAIN HOLE (IF ANY) TO BE AT TOP OF PIPE.
CENTERING PINS USED ON SOME ORIFICES TO AID IN CENTERING ORIFICE PLATE ACCURATELY.
FLOW
K_1 K_2
FLOW NOZZLE MUST ALWAYS BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN PIPE.
BEVELLING OF ORIFICE MUST ALWAYS BE ON OUTLET SIDE.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE, BUT THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
TAP FOR 3/8" PIPE ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLES MUST BE CLEAN AND FREE FROM PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGE OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE.
NAMEPLATE TO BE IN LINE WITH THE NIPPLES. STAMPING ON NAMEPLATE ON INLET SIDE.
3/8" ANGLE VALVES
WATER FLOW RECORDER CONNECTING PIPING USE 1/2" O.D. COPPER TUBING WITH COMPRESSION FITTINGS.
3/8" CONNECTING NIPPLES.
VERTICAL DOWN FLOW FOR WATER BELOW 125° F. AS SHOWN.
VERTICAL UP FLOW HAS K_1 AND K_2 NIPPLE POSITIONS REVERSED.
K_1
K_2
VERTICAL FLOW OF WATER AT TEMPERATURES OF 125° F. TO 250° F. SHOWING DIAGRAMMATIC METHOD OF ROUTING AND LAGGING CONNECTING PIPING BETWEEN K_1 AND K_2 NIPPLES.
LAGGING

FIGURE 10 — Installation of Orifice or Flow Nozzle, Nipples, and Valves for metering the flow of water at temperatures up to 250° F. and pressures not exceeding 900 psi.

the pipe for steam, gas and air installations, and at the top for liquids. In many cases Orifices have two drain holes, so that the Orifice may be rotated 180° in the flange to provide for the installation of the K_1 and K_2 connections in the opposite side of the pipe if required.

The stamped side of the nameplate is the ***inlet side*** of the element, and the Orifice or Nozzle must be installed so that the stamped side of the nameplate is on the inlet side.

If the Orifice is bevelled, the bevelling must be on the outlet side.

Standard Flange

The outside diameter of the Orifice plate or Flow Nozzle flange usually equals the diameter of the bolt circle minus the diameter of the bolt. If, after the bolt circle measurements have been taken, as illustrated in the left hand view of Figure 14, it is found that the bolt circle is not concentric with the hole in the pipe, the circumference of the Orifice plate or Flow Nozzle flange will have to be filed or notched to properly center the element so that the Orifice plate or Nozzle flange can be installed concentric with the hole in the pipe as shown in Figure 14. The hole in the Orifice is made concentric, eccentric or segmental, as required for the conditions of each installation. The throat of the Flow Nozzle is always concentric.

Centering pins are used in many eccentric and segmental Orifices to facilitate the proper centering of these Orifices in the pipe. These pins are so placed in the Orifice plate that the outside diameter of the pins equals the inside pipe diameter on the inlet side. These pins project, therefore, from the inlet face of the Orifice and serve to line up the Orifice with the pipe on the inlet side.

Where gaskets are used, the gasket holes should be cut large enough so that the gaskets do not project into the pipe since this would interfere with the flow through the Primary Element and cause inaccurate metering conditions.

Male and Female or Tongue and Groove Flange

When installed in male and female flanges, or in tongue and groove flanges, the outside diameter of the Orifice or Flow Nozzle is usually so constructed that the element will fit into the recess of the female flange, or inside the tongue of the tongue flange. No nameplate is then used and all legends are engraved on the inlet face of the Orifice or Flow Nozzle. In such cases great care must be taken that the widest or highest part of the eccentric or segmental rim, if eccentric or segmental Orifices are used, be ***directly in line*** between the K_1 and K_2 pressure connections.

Ring Joint Flanges

When ring joint flanges are used, the Orifice fits inside the ring and is attached to the ring or to the inlet flange face. The flange of a Flow Nozzle is grooved, on each side, for rings. In either case, if a ring joint flange is used, a drawing is included in this Instruction Book showing the method of installation.

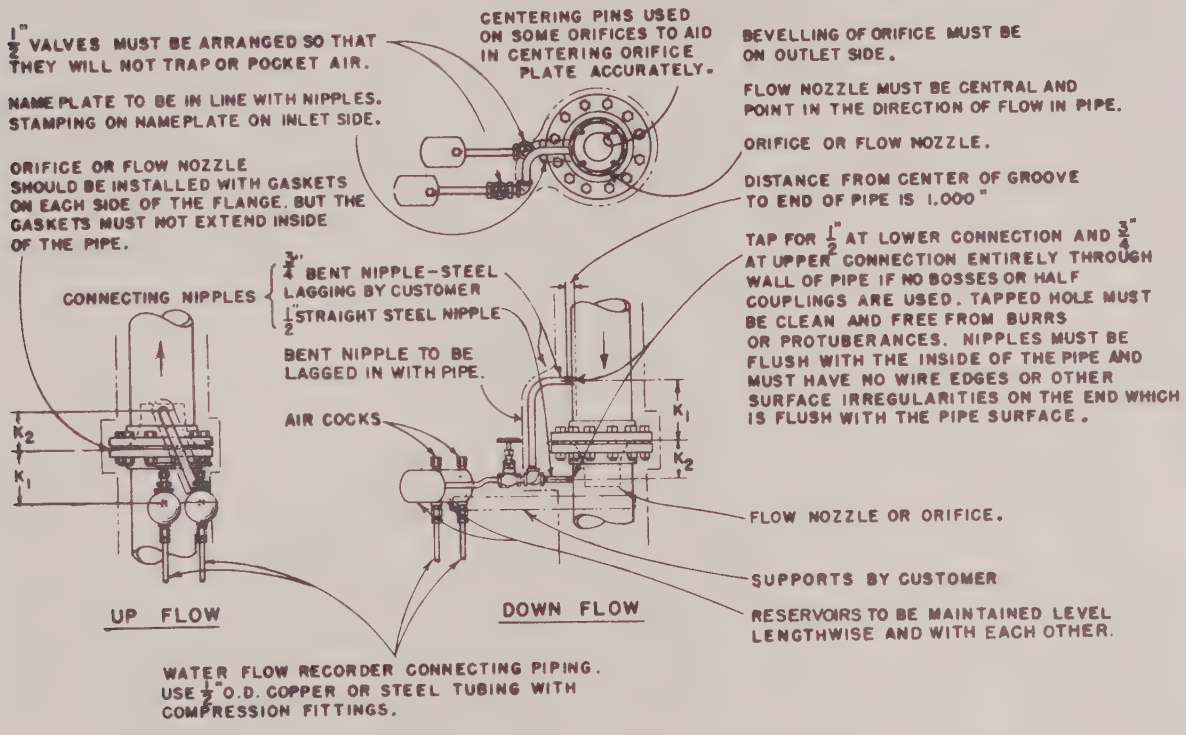

1/2" VALVES MUST BE ARRANGED SO THAT THEY WILL NOT TRAP OR POCKET AIR.
NAME PLATE TO BE IN LINE WITH NIPPLES. STAMPING ON NAMEPLATE ON INLET SIDE.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE. BUT THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
CENTERING PINS USED ON SOME ORIFICES TO AID IN CENTERING ORIFICE PLATE ACCURATELY.
BEVELLING OF ORIFICE MUST BE ON OUTLET SIDE.
FLOW NOZZLE MUST BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN PIPE.
ORIFICE OR FLOW NOZZLE.
DISTANCE FROM CENTER OF GROOVE TO END OF PIPE IS 1.000"
TAP FOR 1/2" AT LOWER CONNECTION AND 3/4" AT UPPER CONNECTION ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLE MUST BE CLEAN AND FREE FROM BURRS OR PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE.
CONNECTING NIPPLES
3/4" BENT NIPPLE-STEEL LAGGING BY CUSTOMER
1/2" STRAIGHT STEEL NIPPLE
BENT NIPPLE TO BE LAGGED IN WITH PIPE.
AIR COCKS
K1
K2
FLOW NOZZLE OR ORIFICE.
SUPPORTS BY CUSTOMER
RESERVOIRS TO BE MAINTAINED LEVEL LENGTHWISE AND WITH EACH OTHER.
UP FLOW
DOWN FLOW
WATER FLOW RECORDER CONNECTING PIPING. USE 1/2" O.D. COPPER OR STEEL TUBING WITH COMPRESSION FITTINGS.

FIGURE 11 — Installation of Orifice or Flow Nozzle, Nipples, Valves, and Reservoirs for hot water in vertical lines. Used for water temperatures of 250° F. and over and pressures not exceeding 900 psi.

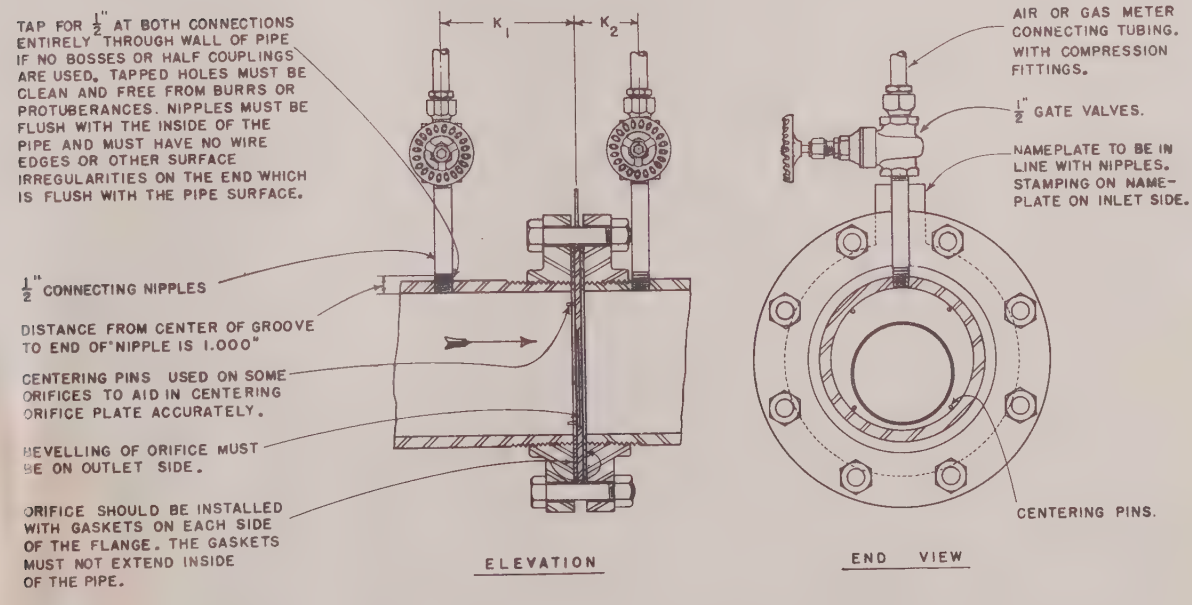
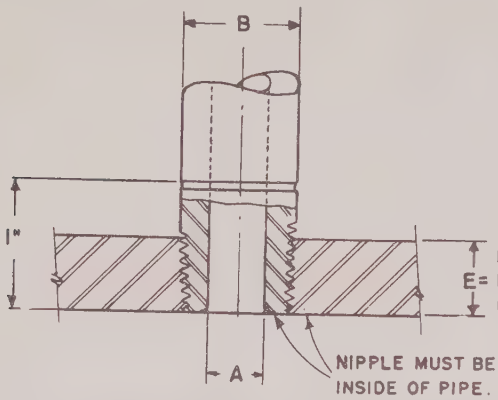
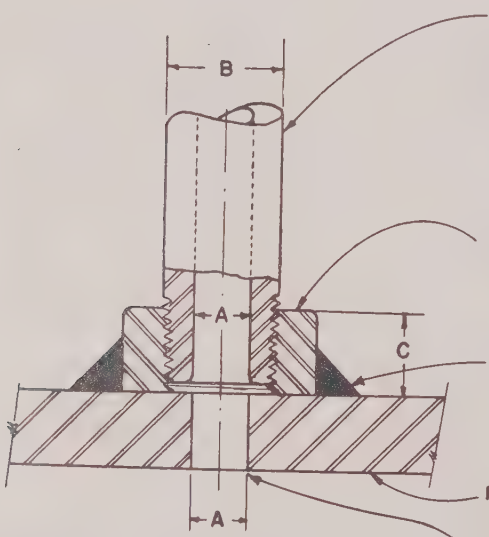

TAP FOR 1/2" AT BOTH CONNECTIONS ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLES MUST BE CLEAN AND FREE FROM BURRS OR PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE.
1/2" CONNECTING NIPPLES
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
CENTERING PINS USED ON SOME ORIFICES TO AID IN CENTERING ORIFICE PLATE ACCURATELY.
BEVELLING OF ORIFICE MUST BE ON OUTLET SIDE.
ORIFICE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF THE FLANGE. THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
K1
K2
ELEVATION
AIR OR GAS METER CONNECTING TUBING. WITH COMPRESSION FITTINGS.
1/2" GATE VALVES.
NAMEPLATE TO BE IN LINE WITH NIPPLES. STAMPING ON NAME-PLATE ON INLET SIDE.
CENTERING PINS.
END VIEW

FIGURE 12 — Installation of Orifice, Nipples, and Valves for metering the flow of air, gas, or non-condensible vapors.



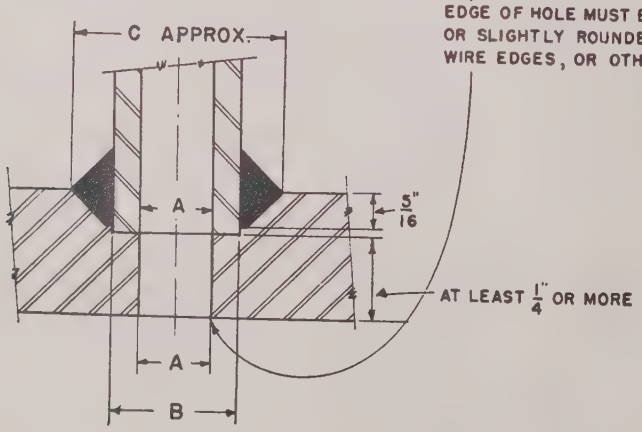
SIZE OF NIPPLE	A	B	E
3/8"	7/16"	11/16"	3/8"
1/2"	7/16"	7/8"	1/2"
3/4"	5/8"	1 1/16"	1/2"
1"	13/16"	1 5/16"	9/16"

STANDARD SCREWED TYPE OF PRESSURE CONNECTION.


NIPPLE SCREWED IN AS FAR AS POSSIBLE OR UNTIL BOTTOM IS BUT 1/32" TO 1/16" ABOVE BOTTOM OF TAPPED HOLE.
B
FORGED STEEL COUPLING CUT TO SUIT.
A
C
HEAVY WELD
PIPE WALL
A

SIZE OF NIPPLE	A	B	C
3/8"	7/16"	11/16"	1/2"
1/2"	7/16"	7/8"	9/16"
3/4"	5/8"	1 1/16"	11/16"
1"	13/16"	1 5/16"	13/16"

STANDARD SCREWED TYPE USING HALF COUPLING.


EDGE OF HOLE MUST BE CLEAN AND SHARP OR SLIGHTLY ROUNDED. FREE FROM BURRS, WIRE EDGES, OR OTHER IRREGULARITIES.
C APPROX.
A
5/16
AT LEAST 1/4" OR MORE
A
B

SIZE OF NIPPLE	A	B	C
3/8"	7/16"	11/16"	1 7/16"
1/2"	7/16"	7/8"	1 5/8"
3/4"	5/8"	1 1/16"	1 13/16"
1"	13/16"	1 5/16"	2 1/16"

WELDED TYPE

FIGURE 13 — Approved Pressure Connections into Pipes.

Welding Neck Flange

If the Orifice or Flow Nozzle is installed between welding neck flanges, see Instruction Section M11.

Orifice or Flow Nozzle Pipes or Holding Ring Flow Nozzles

When Orifice or Flow Nozzle Pipes, or Holding Ring (welded-in) Flow Nozzles installed in pipe sections, are used, install the pipe section directly in the line. Take care that the pipe is installed so that the drain hole is in its proper location as explained in the first paragraph in the section "Installing the Orifice or Nozzle" and that the pipe section is installed so that the flow through the pipe is in the right direction (an arrow indicating the direction of flow is stamped on the flange of the Orifice or Flow Nozzle Pipe). If the pipe section is installed in a vertical line, bent nipples must be used as shown in Figures 8, 9, 11 and 15. The preparation of the pipe section and the installation of the Holding Ring Flow Nozzle are covered in Instruction Sections M11 and M12 respectively. Figure 16 shows the Orifice or Flow Nozzle Pipe and gives dimensions for various size pipes.

VALVES

All valves must be installed in the positions illustrated in the Figure drawings included herein. All valves ***must*** close ***against*** the pressure.

RESERVOIRS

Steam

For steam installation from 25 to 900 psi pressure and below 750° F. temperature, reservoirs must be installed as shown in Figures 6, 7, 8 and 9. The reservoirs are always installed level lengthwise and with each other. Supports should be used to insure their being kept level and free from excessive vibration.

Reservoirs are used to keep the connecting piping completely filled with water, the offset nipple at the reservoir being used as a dam. The reservoirs are equipped with vent cocks to permit the release of any entrapped air.

In the case of steam at pressures of 25 psi or less, large area reservoirs are required to insure rapid return of the meter mechanism to zero when the steam flow is cut off. The horizontal and vertical installation of these nipples is shown in Figure 15. Note that, in the event that the sum of the K_1 and K_2 connections is less than 12″, at least one nipple must be equipped with a 45° elbow in order that the reservoirs will clear each other.

In steam installations where the Primary Element must be located below the meter, if the vertical distance between the meter and the Primary Element is so great that the pressure in the system cannot keep the tubing full of water at all rates of

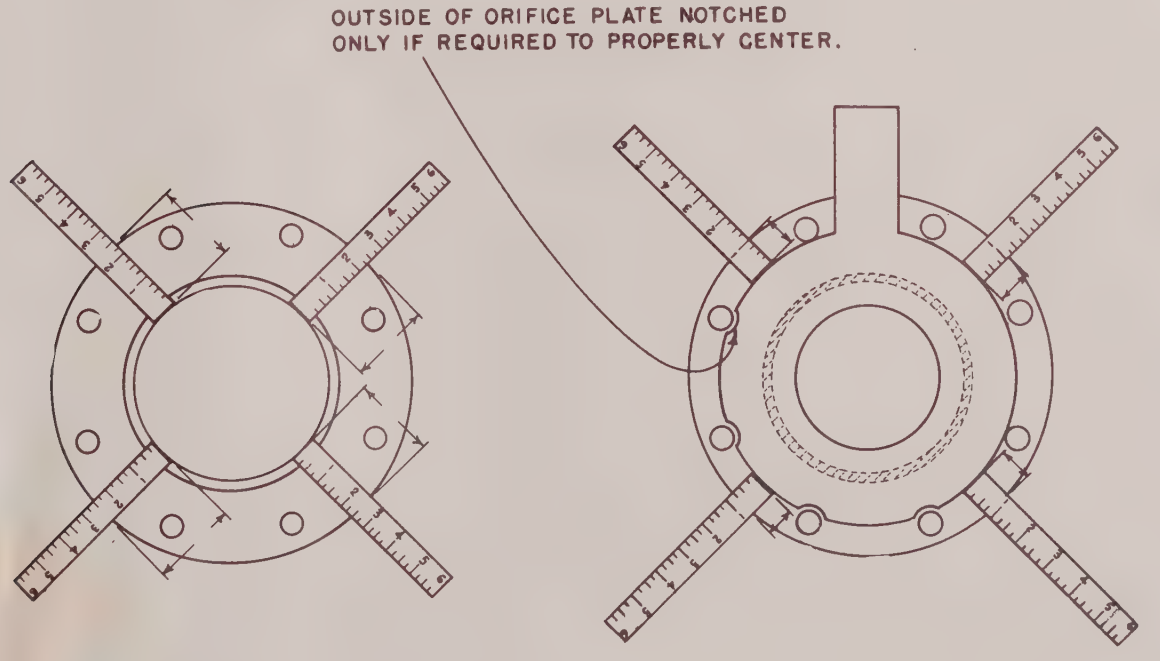

OUTSIDE OF ORIFICE PLATE NOTCHED
ONLY IF REQUIRED TO PROPERLY CENTER.
MEASURING CONCENTRICITY OF FLANGE.
MEASURING TO CHECK CONCENTRICITY OF
OUTSIDE DIAMETER OF ORIFICE PLATE IN PIPE.

FIGURE 14 — Centering of Orifice Plate or Flow Nozzle by outside diameter of Orifice Plate or Flow Nozzle.

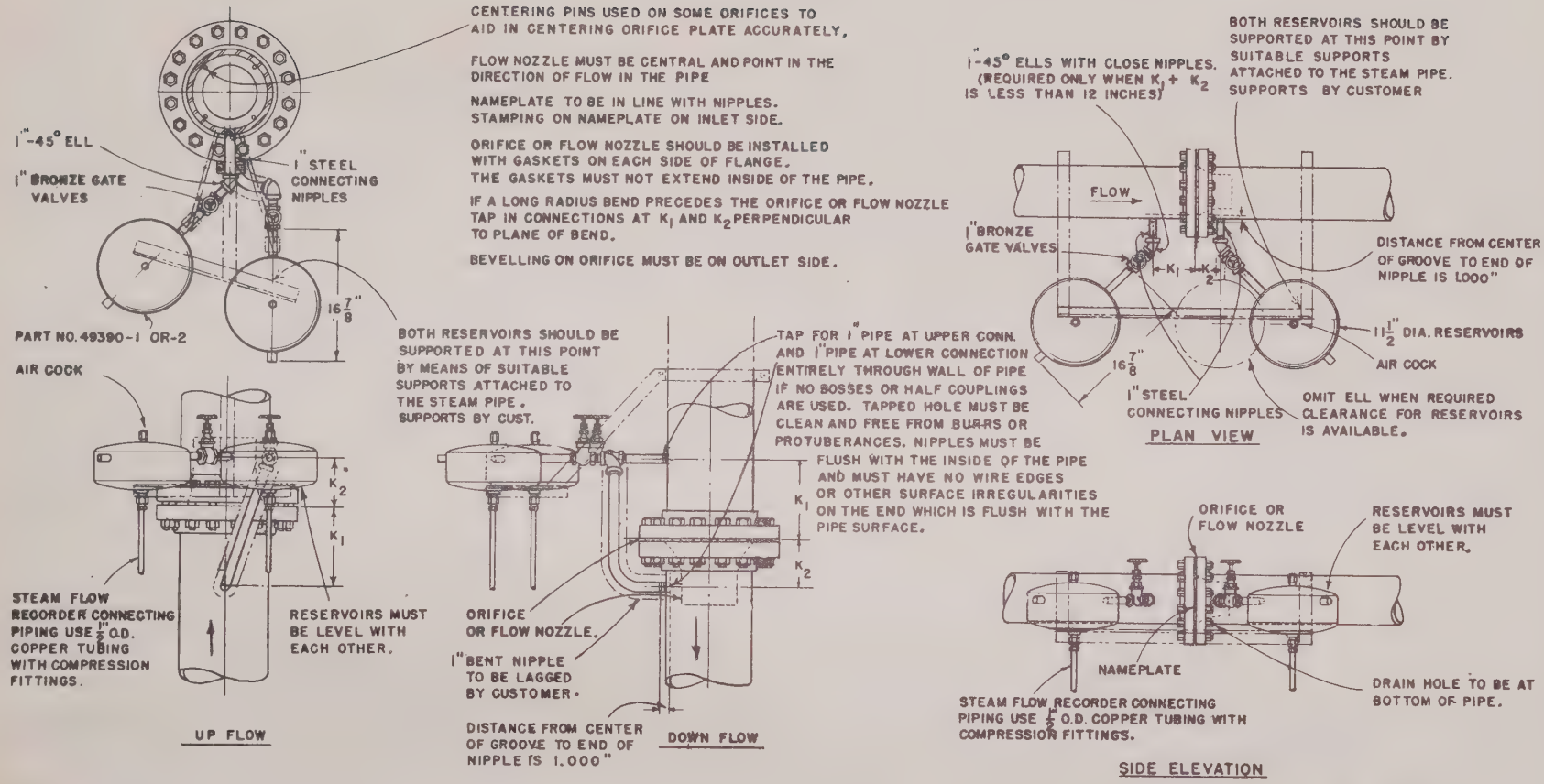

CENTERING PINS USED ON SOME ORIFICES TO AID IN CENTERING ORIFICE PLATE ACCURATELY.
FLOW NOZZLE MUST BE CENTRAL AND POINT IN THE DIRECTION OF FLOW IN THE PIPE
NAMEPLATE TO BE IN LINE WITH NIPPLES. STAMPING ON NAMEPLATE ON INLET SIDE.
ORIFICE OR FLOW NOZZLE SHOULD BE INSTALLED WITH GASKETS ON EACH SIDE OF FLANGE. THE GASKETS MUST NOT EXTEND INSIDE OF THE PIPE.
IF A LONG RADIUS BEND PRECEDES THE ORIFICE OR FLOW NOZZLE TAP IN CONNECTIONS AT K1 AND K2 PERPENDICULAR TO PLANE OF BEND.
BEVELLING ON ORIFICE MUST BE ON OUTLET SIDE.
1"-45° ELL
1" BRONZE GATE VALVES
1" STEEL CONNECTING NIPPLES
16 7/8"
PART NO. 49390-1 OR-2
AIR COCK
K2
K1
STEAM FLOW RECORDER CONNECTING PIPING USE 1/2" O.D. COPPER TUBING WITH COMPRESSION FITTINGS.
RESERVOIRS MUST BE LEVEL WITH EACH OTHER.
UP FLOW
BOTH RESERVOIRS SHOULD BE SUPPORTED AT THIS POINT BY MEANS OF SUITABLE SUPPORTS ATTACHED TO THE STEAM PIPE. SUPPORTS BY CUST.
TAP FOR 1" PIPE AT UPPER CONN. AND 1" PIPE AT LOWER CONNECTION ENTIRELY THROUGH WALL OF PIPE IF NO BOSSES OR HALF COUPLINGS ARE USED. TAPPED HOLE MUST BE CLEAN AND FREE FROM BURRS OR PROTUBERANCES. NIPPLES MUST BE FLUSH WITH THE INSIDE OF THE PIPE AND MUST HAVE NO WIRE EDGES OR OTHER SURFACE IRREGULARITIES ON THE END WHICH IS FLUSH WITH THE PIPE SURFACE.
K1
K2
ORIFICE OR FLOW NOZZLE.
1" BENT NIPPLE TO BE LAGGED BY CUSTOMER.
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
DOWN FLOW
INSTALLATION IN VERTICAL STEAM LINES
SHOWING METHOD OF CONNECTING LARGE RESERVOIRS
1"-45° ELLS WITH CLOSE NIPPLES. (REQUIRED ONLY WHEN K1 + K2 IS LESS THAN 12 INCHES)
BOTH RESERVOIRS SHOULD BE SUPPORTED AT THIS POINT BY SUITABLE SUPPORTS ATTACHED TO THE STEAM PIPE. SUPPORTS BY CUSTOMER
FLOW
1" BRONZE GATE VALVES
K1
K2
DISTANCE FROM CENTER OF GROOVE TO END OF NIPPLE IS 1.000"
11 1/2" DIA. RESERVOIRS
AIR COCK
16 7/8"
1" STEEL CONNECTING NIPPLES
OMIT ELL WHEN REQUIRED CLEARANCE FOR RESERVOIRS IS AVAILABLE.
PLAN VIEW
ORIFICE OR FLOW NOZZLE
RESERVOIRS MUST BE LEVEL WITH EACH OTHER.
NAMEPLATE
DRAIN HOLE TO BE AT BOTTOM OF PIPE.
STEAM FLOW RECORDER CONNECTING PIPING USE 1/2" O.D. COPPER TUBING WITH COMPRESSION FITTINGS.
SIDE ELEVATION
INSTALLATION IN HORIZONTAL STEAM LINES
SHOWING METHOD OF CONNECTING LARGE RESERVOIRS
OFFSET NECESSARY TO PROVIDE CLEARANCE WHEN DISTANCE K1 + K2 IS LESS THAN 12"

FIGURE 15 — Installation of Orifice or Flow Nozzle, Nipples, Valves, and Reservoirs for pressures up to 25 psi.

SIZE OF PIPE - INCHES	1	1½	2	2½	3	3½	4
LENGTH A - INCHES	19	29	38	47	56	65	74
LENGTH B - INCHES	16½	26½	35½	43¾	52¾	61½	70½

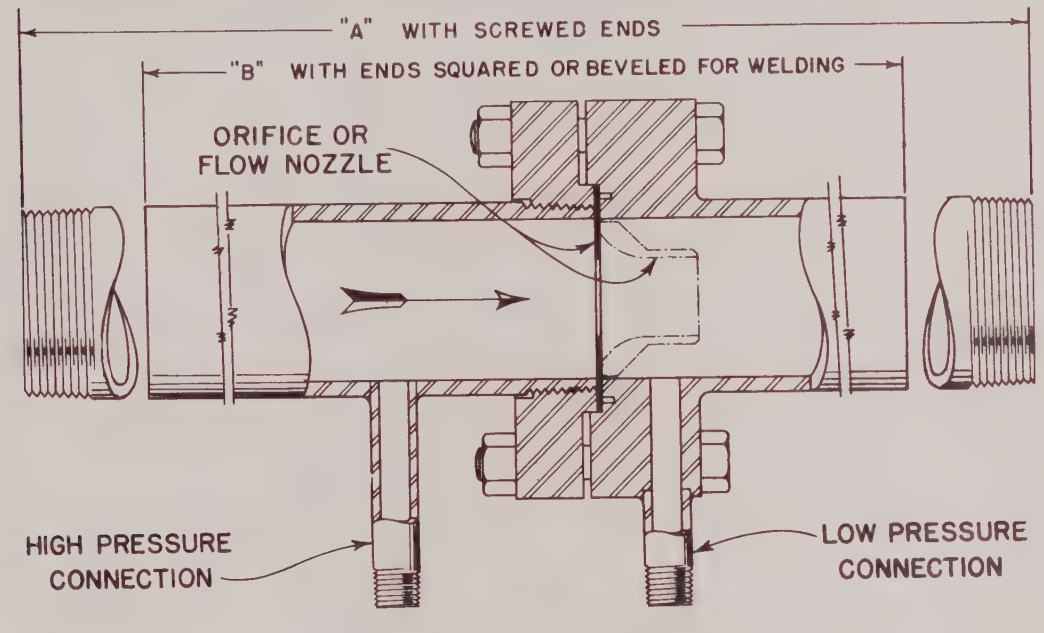


FIGURE 16 — Bailey Orifice or Flow Nozzle Pipe.

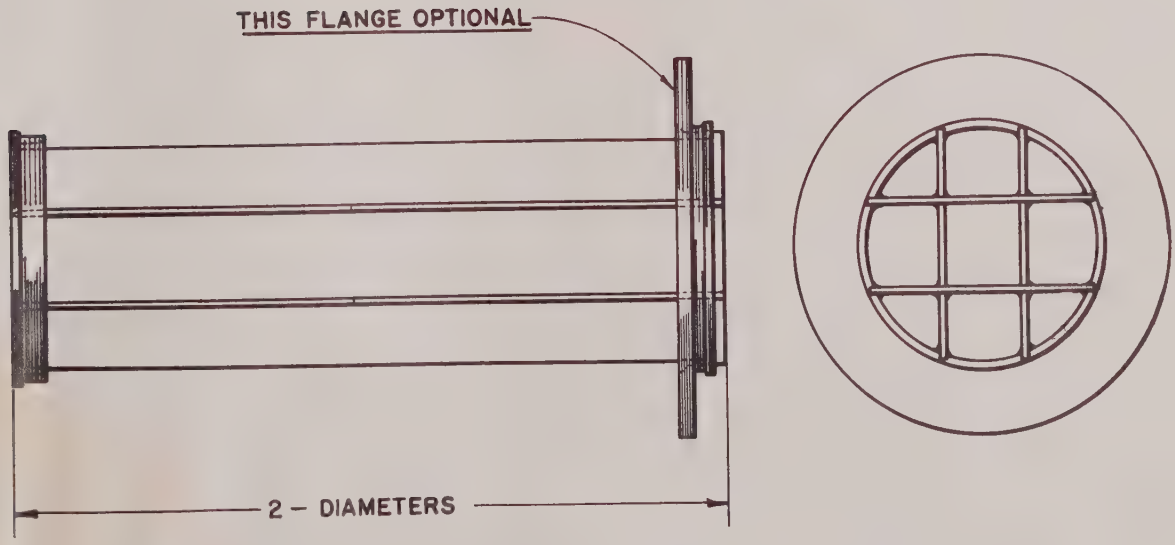


FIGURE 17 — Bailey Flange Type Straightening Vane.

flow, then it is of prime importance that a special system of piping to the reservoir be used. A special drawing showing this type of installation will be enclosed with these instructions when this condition is known to exist.

In cases where the vertical distance between the K_1 and K_2 nipples in vertical steam installations is greater than 20 inches, it will be necessary to install a drain back tube to prevent the possibility of condensate "hanging up" in the bent nipple, which would cause an inaccuracy in the metering. The Instruction Book will contain a drawing showing the proper method of piping layout in instances where such installations must be made.

Hot Water

Reservoirs should be used in Primary Element installations measuring water at temperatures of 250° F. and over, in order to keep the temperature conditions in each leg of the connecting piping evenly balanced. It is evident that in the normal operation of the meter, the displacement of water in the meter will cause an unbalanced temperature condition to exist in the connecting lines unless there is a storage of comparatively cool water from which to draw. With the use of reservoirs this condition is prevented, since there is always a sufficient volume of relatively cool water in the reservoirs to replace the water which may be drawn into the meter bell casing.

Connecting nipples, valves and reservoirs may be ordered from the Bailey Meter Company. They are not furnished with either the Meter or the Primary Element unless ordered separately.

NOTE: It is important to use this Primary Element with the meter for which it was designed and which is listed on the Specification Sheet. If it is used with another meter than the one listed, make sure that both the meter and the Primary Element are designed for the same fluid, and the same differential pressure at the given capacity. Consult one of our Service Engineers, or write directly to our Cleveland Main Office, when such changes are contemplated.

BAILEY METER COMPANY

1050 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

10 M Litho. in U.S.A. 3-45

INSTRUCTIONS

SECTION M 20-A

FOR

INSTALLATION OF CONNECTING PIPING

USED WITH

BAILEY METERS

FOR MEASURING FLOW OF STEAM, LIQUIDS, AIR AND GASES

BAILEY METER COMPANY

CLEVELAND, OHIO

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SELECTION OF MATERIALS

Selection of the kind and size of tubing for connecting lines used between the primary element in the pipe line and the meter should take into consideration such factors as the kind of fluid being measured, pressure and temperature of the fluid, distance between primary element and meter, and availability of desired materials.

COPPER TUBING

By reference to the Selection Chart, Figure 1, it will be noted that ½-inch O. D. extra heavy soft annealed copper tubing and compression fittings are recommended for steam, water, oil, brine, and most other liquids up to 600 lb. pressure, 750° F. temperature where the distance between the primary element and the meter is less than 100 feet. Copper tubing and compression fittings are easily and economically installed, they result in tight joints, present a clean, neat appearance, and most important, they remain rust-free under most conditions, thus requiring a minimum of maintenance and replacement.

Copper tubing in the ½-inch O. D. size is supplied in lengths of approximately 35 or 50 feet. It is shipped in coils, but can be easily straightened by using a rubber mallet or a wide wooden block. Copper tubing can be easily bent for changes in direction requiring fewer fittings and joints than many other piping materials.

COMPRESSION FITTINGS

The Selection Chart, Figure 1, indicates that heavy weight XX brass fittings are suitable for pressures up to 800 lb. at a temperature of 500° F. Above 500° F., heavy weight XX carbon steel fittings are recommended. These two types of fittings can be used for the great majority of operating conditions, the latter being especially recommended for use with high pressure superheated steam flow and water flow meters. Figure 2 illustrates several available forms of compression fittings.

STEEL TUBING OR STEEL PIPE

For fluid conditions which fall outside the limits prescribed for copper tubing, (See Figure 1) either ½-inch or ⅝-inch O. D. steel tubing is used. This tubing is usually furnished in straight lengths of approximately 20 feet.

For pressures above 1200 lb. and temperatures above 900° F., we recommend the use of steel tubing with socket welding fittings as indicated in Figure 1.

When Type C, CA, or CH meters are being used for measuring air and gases, we suggest the use of ⅜-inch steel pipe with screwed fittings, while for Type CG meters, ½-inch steel pipe with screwed fittings should be used.

In all cases where the distance between the meter and primary element is greater than 100 feet, our Engineering Department should be consulted for further recommendations.

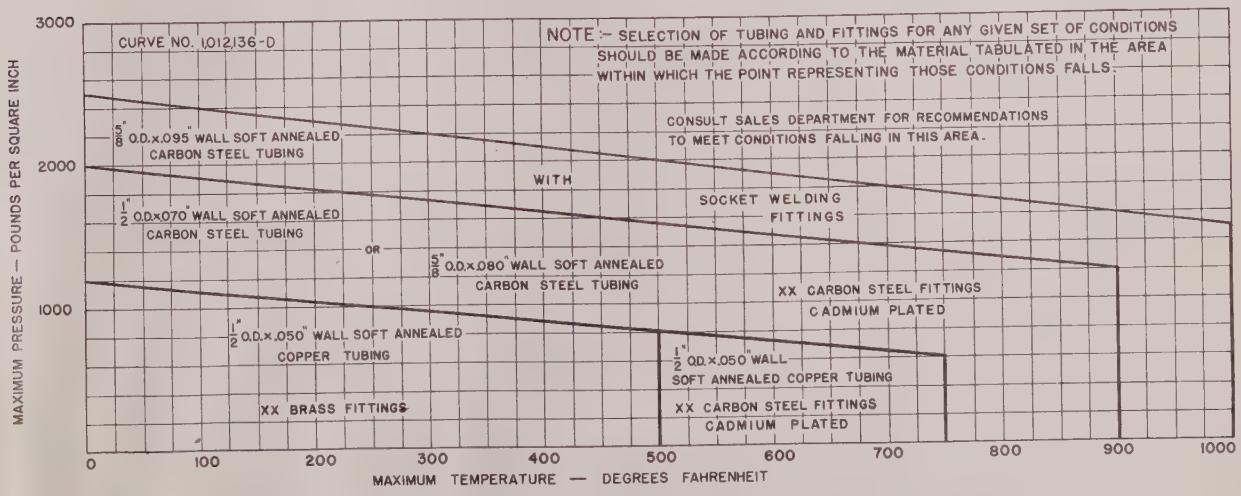

CURVE NO. 1012136-D
NOTE:- SELECTION OF TUBING AND FITTINGS FOR ANY GIVEN SET OF CONDITIONS SHOULD BE MADE ACCORDING TO THE MATERIAL TABULATED IN THE AREA WITHIN WHICH THE POINT REPRESENTING THOSE CONDITIONS FALLS.
CONSULT SALES DEPARTMENT FOR RECOMMENDATIONS TO MEET CONDITIONS FALLING IN THIS AREA.
⅝" O.D.x.095" WALL SOFT ANNEALED CARBON STEEL TUBING
WITH
SOCKET WELDING FITTINGS
½" O.D.x.070" WALL SOFT ANNEALED CARBON STEEL TUBING
OR
⅝" O.D.x.080" WALL SOFT ANNEALED CARBON STEEL TUBING
XX CARBON STEEL FITTINGS CADMIUM PLATED
½" O.D.x.050" WALL SOFT ANNEALED COPPER TUBING
½" O.D.x.050" WALL SOFT ANNEALED COPPER TUBING
XX CARBON STEEL FITTINGS CADMIUM PLATED
XX BRASS FITTINGS
MAXIMUM PRESSURE — POUNDS PER SQUARE INCH
3000
2000
1000
0
100
200
300
400
500
600
700
800
900
1000
MAXIMUM TEMPERATURE — DEGREES FAHRENHEIT

FIGURE 1 — Chart for Selection of Tubing and Fittings for Meter Connecting Piping.

ORDERING TUBING AND FITTINGS

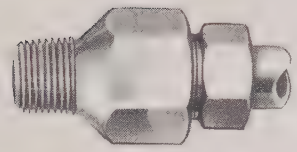
Copper and steel tubing, as well as brass and steel compression fittings can be furnished by Bailey Meter Company. When ordering for any specific job, please advise: —

1. Kind of fluid being measured, and its pressure and temperature.
2. Length required for the two connecting lines.
3. Whether brass or steel fittings are required.
4. The number of two-foot riser and air cock assemblies required for the installation. (See Figures 5, 6, 7, 8 and 9.)

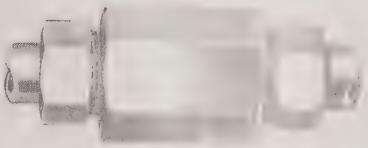
METER VALVES

Operating pressures up to 800 lb. and temperatures up to 750° F., require the use of ⅜-inch forged steel valves directly above the meter, as shown in Figures 3 to 7.

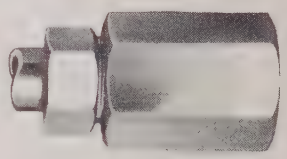
For those meters designed for pressures exceeding 800 lb., the piping at the meter bell casing is furnished either with square ends for welding or with ground tail-welded forged steel unions. In such cases ¾-inch forged steel 1500 lb. standard valves with both ends equipped either with welding sockets or with ½ I.P.S. threads are required.



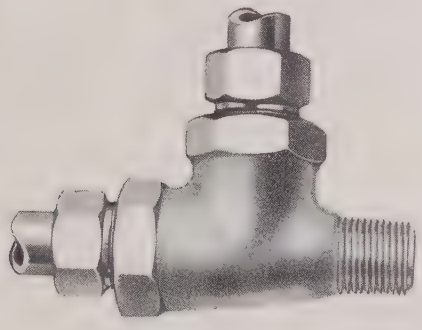
Heavy Weight Brass Male I. P. T. Connector, Style FBXX.



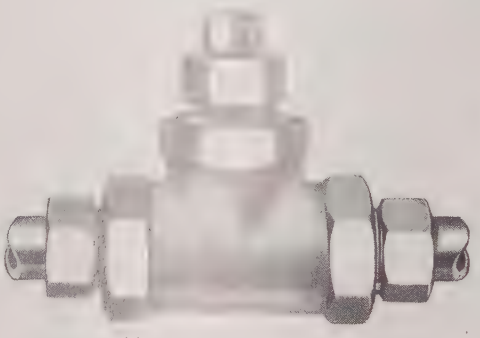
Heavy Weight Brass Tube Union, Style HBBXX.



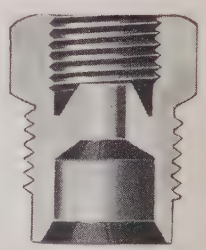
Heavy Weight Brass Female I. P. T. Connector, Style GBXX.



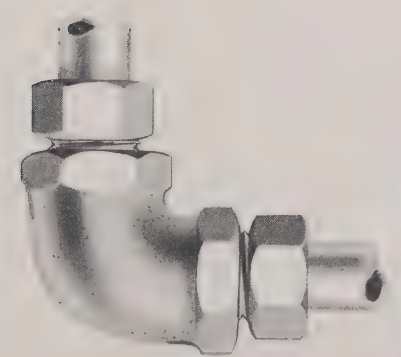
Heavy Weight Brass Male I. P. T. Run Tee, Style RBBXX.



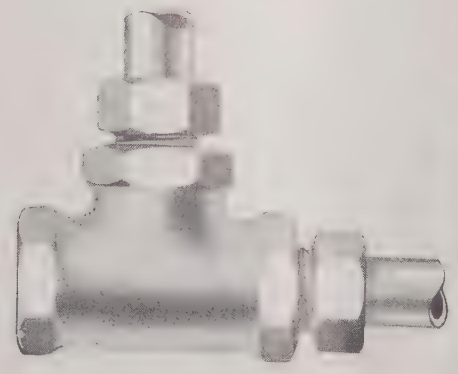
Heavy Weight Brass Tube Tee, Style JBBBXX.



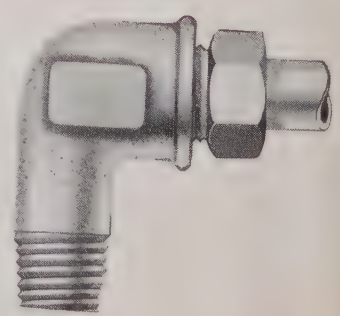
Heavy Weight Brass Reducing Tube Nut.



Heavy Weight Brass Tube Elbow Style EBBXX.



Heavy Weight Brass Female I.P.T. Run Tee, Style MBBXX.



Heavy Weight Brass Male I.P.T. Elbow, Long, Style CCBXX.

FIGURE 2 — Typical Dieform Fittings.

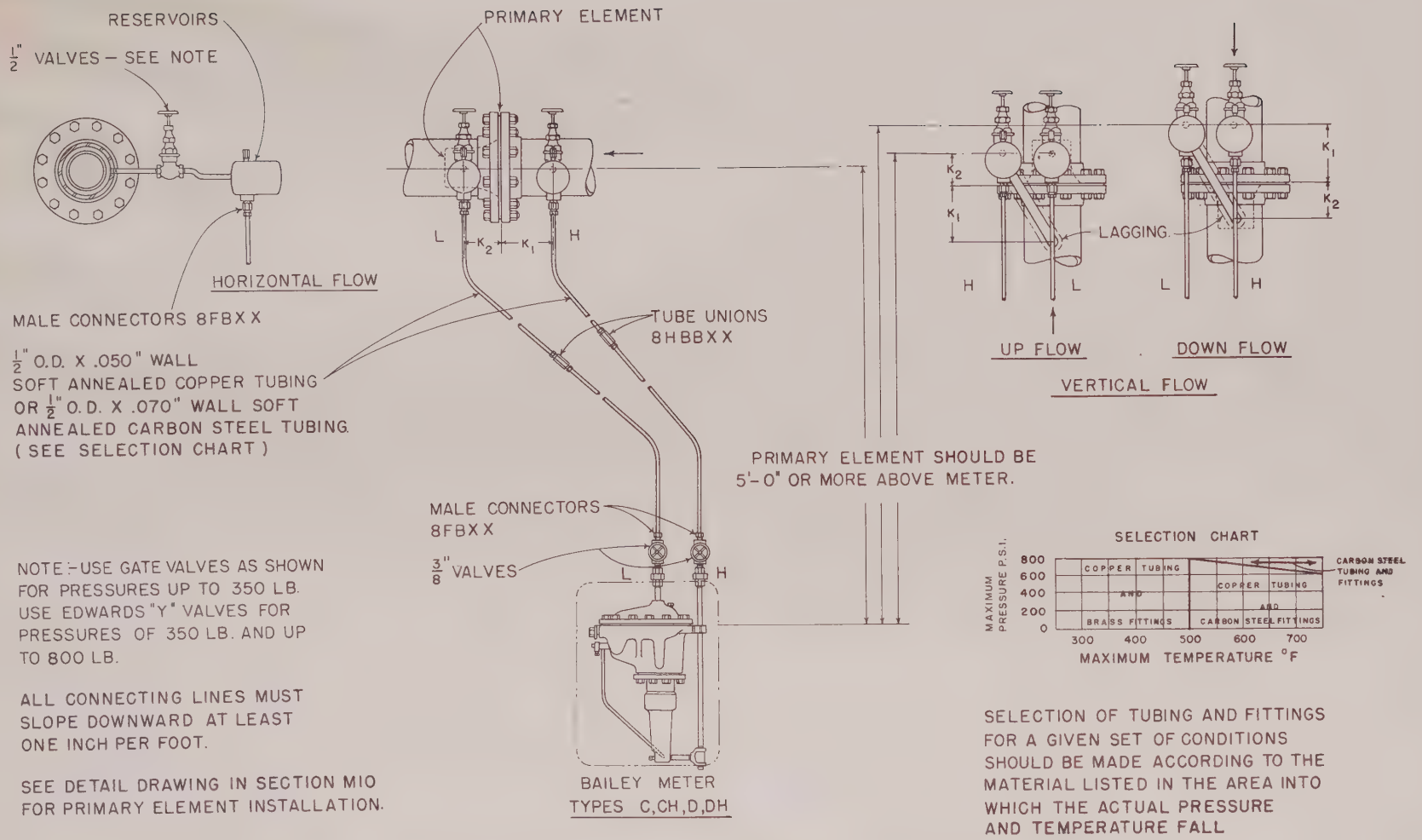

RESERVOIRS
1/2" VALVES – SEE NOTE
HORIZONTAL FLOW
MALE CONNECTORS 8FBXX
1/2" O.D. X .050" WALL SOFT ANNEALED COPPER TUBING OR 1/2" O.D. X .070" WALL SOFT ANNEALED CARBON STEEL TUBING (SEE SELECTION CHART)
PRIMARY ELEMENT
L
K2
K1
H
TUBE UNIONS 8HBBXX
PRIMARY ELEMENT SHOULD BE 5'-0" OR MORE ABOVE METER.
MALE CONNECTORS 8FBXX
3/8" VALVES
BAILEY METER TYPES C,CH,D,DH
LAGGING
UP FLOW
DOWN FLOW
VERTICAL FLOW
SELECTION CHART
MAXIMUM PRESSURE P.S.I.
800
600
400
200
0
COPPER TUBING AND BRASS FITTINGS
COPPER TUBING AND CARBON STEEL FITTINGS
CARBON STEEL TUBING AND FITTINGS
300
400
500
600
700
MAXIMUM TEMPERATURE °F
NOTE:-USE GATE VALVES AS SHOWN FOR PRESSURES UP TO 350 LB. USE EDWARDS "Y" VALVES FOR PRESSURES OF 350 LB. AND UP TO 800 LB.
ALL CONNECTING LINES MUST SLOPE DOWNWARD AT LEAST ONE INCH PER FOOT.
SEE DETAIL DRAWING IN SECTION M10 FOR PRIMARY ELEMENT INSTALLATION.
SELECTION OF TUBING AND FITTINGS FOR A GIVEN SET OF CONDITIONS SHOULD BE MADE ACCORDING TO THE MATERIAL LISTED IN THE AREA INTO WHICH THE ACTUAL PRESSURE AND TEMPERATURE FALL

FIGURE 3 —Typical Installation of Connecting Lines for Steam Flow Measurement with Meter Below Primary Element, for pressures from 25 lb. to 800 lb. and temperatures up to 750° F.

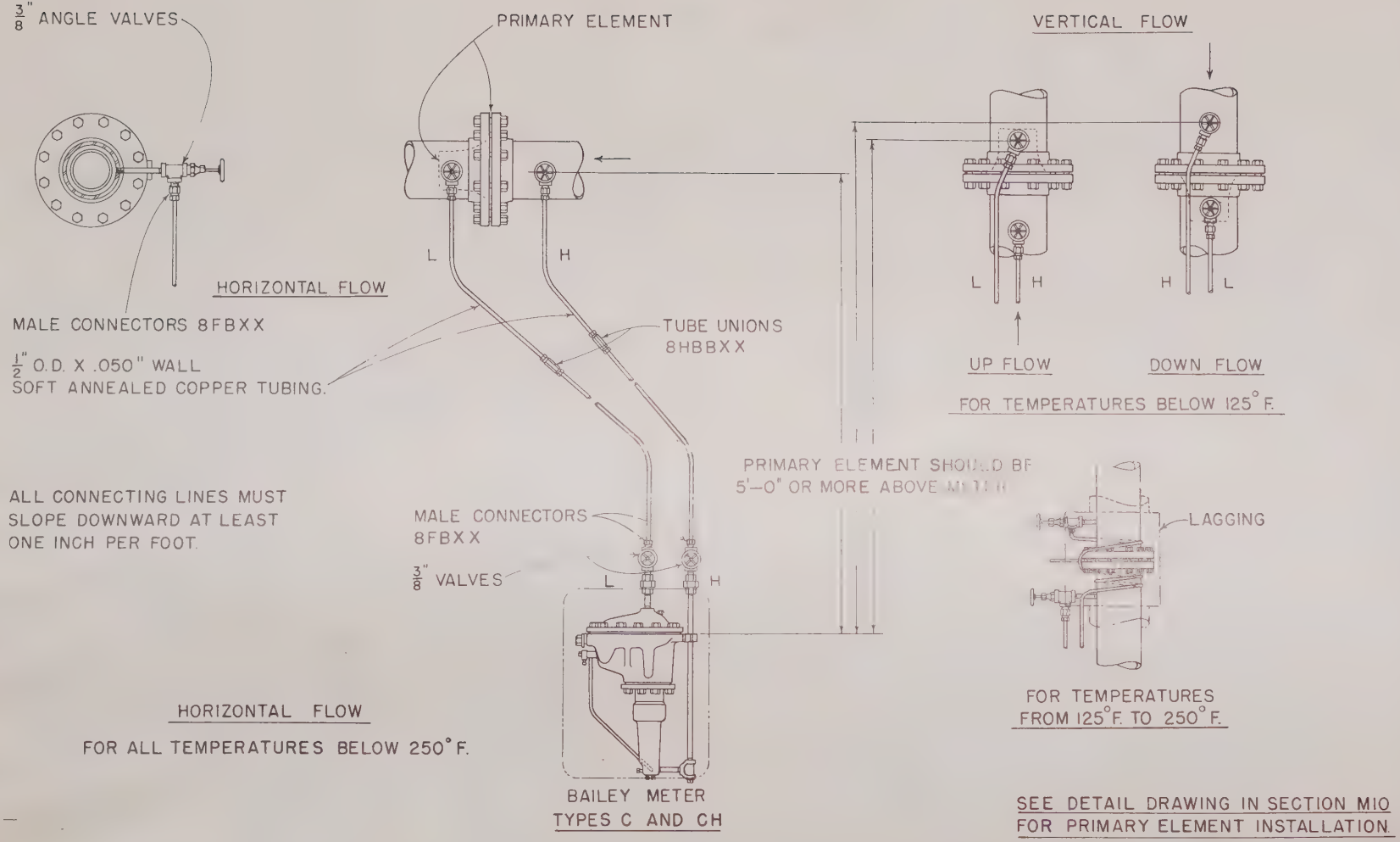


FIGURE 4 —Typical Installation of Connecting Lines for Water Flow Measurement with Meter Below Primary Element, for pressures not exceeding 800 lb. and temperatures below 250° F.

INSTALLATION

Routing of the lines from primary element to meter should conform to certain practices which have been found necessary for trouble-free operation in installations of each type. These are shown diagrammatically in Figures 3 to 10 and cover the following general applications: —

STEAM, WATER AND NON-CORROSIVE LIQUIDS

The general arrangement of the connecting tubing is the same regardless of whether the fluid being measured is steam, water, or other non-corrosive liquids, and regardless of operating pressure and temperature.

Figures 3, 4 and the left-hand view of Figure 7, show the simplest and most economically arranged systems. It will be noted that the meter is below the orifice or other primary element, so that the connecting tubing can be run directly between the two. This arrangement is used whether the flow at the primary element is horizontal or vertical. Note, however, that the meter should be 5 feet or more below the primary element.

Occasionally it is necessary to connect the meter to an orifice or flow nozzle located below the meter, or at an insufficient height above the meter to allow the tubing to be sloped at least one inch per foot. In such cases it is preferable to arrange the tubing with drop legs below the primary element, as shown in Figures 5, 6 and the center view in Figure 7. The lowest point of the drop leg should be approximately five feet below the axial center of the pipe line. The tubing should slope downward from the shortest vertical leg. Vertical risers with air cocks must be installed at the top of the vertical run of tubing to the meter to discharge accumulations of air. Tubing from the riser must slope downward to the meter. Line pressure must be able to support a water column from the primary element to the meter at any rate of flow.

With substitution of proper materials, the arrangements shown in Figures 3 to 7 also apply to higher operating pressures and temperatures than those listed.

Settling Chambers. The connecting tubing should be kept clean for best results. Sometimes the steam or liquid being measured carries considerable sediment which collects in the connecting tubing and occasionally accumulates in the meter bell casing. Where this is apt to occur, it is advisable to install settling chambers close to the meter as shown in Figure 8. Sediment will accumulate in the bottom of the settling chambers from which it can be blown out as often as necessary. When blowing out these chambers, it is necessary first to shut off the meter, following the instructions on the upper left-hand note on Figure 8. These chambers may be obtained from the Bailey Meter Company.

LOW PRESSURE STEAM

In all cases where the steam pressures are less than 25 pounds, a large size special reservoir should be used. In all other respects, the arrangements of connecting tubing are the same as shown in Figures 3 and 5.

In special cases where the pressure in the system cannot support a water column equal to the vertical distance between the pipe line and the meter, a special method of installation is required. A drawing illustrating the manner in which these installations are made will be furnished in the instruction book when this condition is known to exist.

OILS, CHEMICALS, OR CORROSIVE MATERIALS

Separating Chambers can be furnished when the metered liquid consists of chemical, brine, oil, etc., or any liquid which might attack the internal meter parts. These separate the line liquid from the clean water in the meter and thus keep the meter in good operating service under conditions that would otherwise be very troublesome.

Figure 9 illustrates a typical installation of separating chambers in measuring the flow of a liquid such as oil which is lighter than and not miscible with water.

Certain special services, such as the measurement of black liquor flow, require a special arrangement of these chambers. In such cases, a drawing showing this installation will be enclosed in the instruction book.

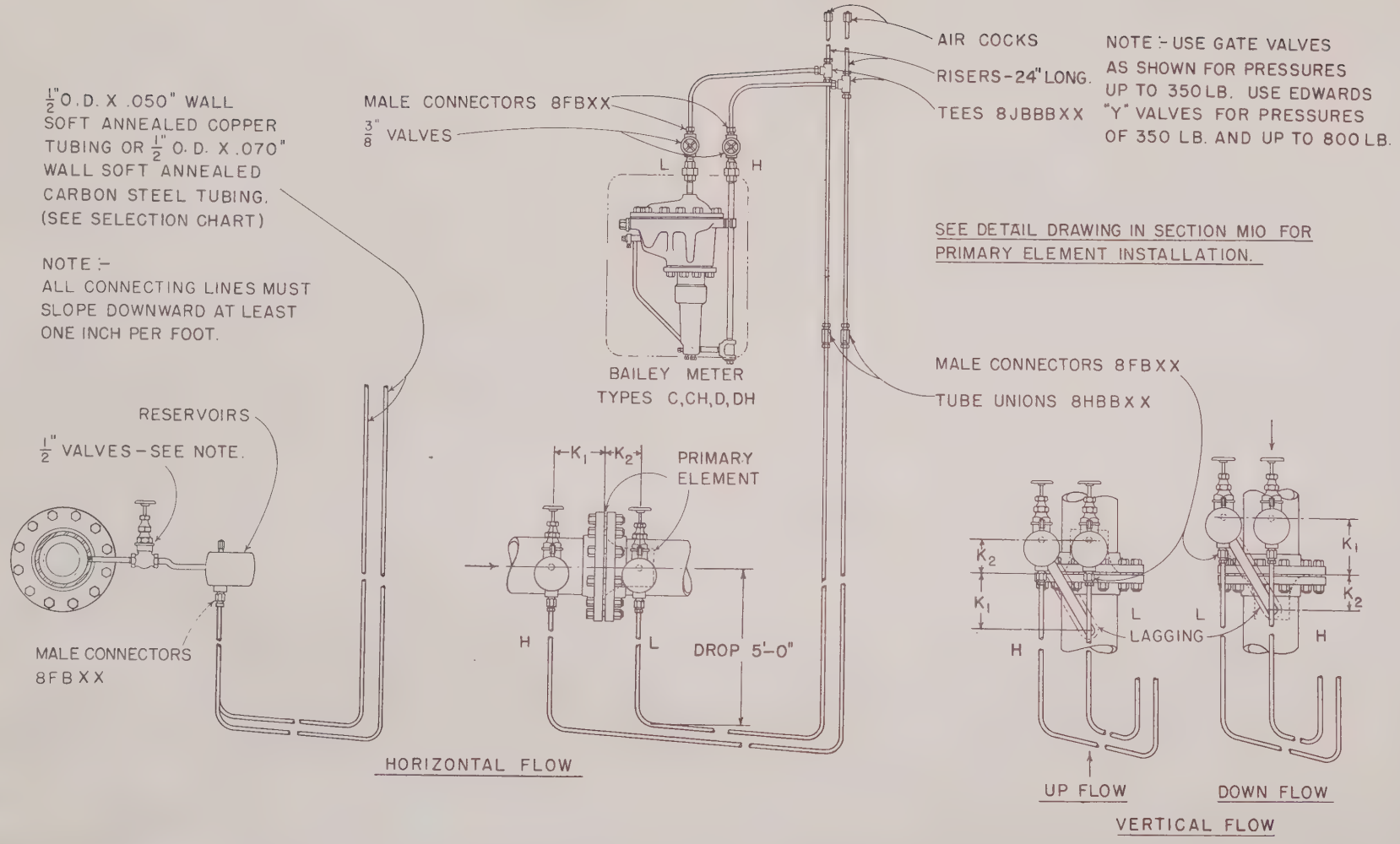

½"O.D. X .050" WALL SOFT ANNEALED COPPER TUBING OR ½" O.D. X .070" WALL SOFT ANNEALED CARBON STEEL TUBING. (SEE SELECTION CHART)
NOTE :- ALL CONNECTING LINES MUST SLOPE DOWNWARD AT LEAST ONE INCH PER FOOT.
MALE CONNECTORS 8FBXX
⅜" VALVES
AIR COCKS
RISERS-24" LONG.
TEES 8JBBBXX
NOTE :- USE GATE VALVES AS SHOWN FOR PRESSURES UP TO 350 LB. USE EDWARDS "Y" VALVES FOR PRESSURES OF 350 LB. AND UP TO 800 LB.
SEE DETAIL DRAWING IN SECTION M10 FOR PRIMARY ELEMENT INSTALLATION.
L
H
BAILEY METER TYPES C,CH,D,DH
MALE CONNECTORS 8FBXX
TUBE UNIONS 8HBBXX
RESERVOIRS
½" VALVES - SEE NOTE.
MALE CONNECTORS 8FBXX
K1
K2
PRIMARY ELEMENT
DROP 5'-0"
HORIZONTAL FLOW
LAGGING
UP FLOW
DOWN FLOW
VERTICAL FLOW

FIGURE 5 —Typical Installation of Connecting Lines for Steam Flow Measurement with Meter Above Primary Element, for pressures from 25 lb. to 800 lb. and temperatures up to 750° F.

GAS, AIR, OR NON-CONDENSABLE VAPOR

The simplest arrangement is generally obtained when the meter is installed above the orifice or nozzle. Connecting lines must be sloped one inch per foot or more toward the primary element. See Figure 10.

When the meter is below the orifice or nozzle, the piping running from the primary element to the vertical drop should be sloped downward toward the primary element. When the gas contains moisture, dirt, or other extraneous materials, install settling chambers in the piping at the meter so that such materials may be collected and blown out from time to time.

All nipples and valves in the immediate vicinity of the primary element should be arranged so as to allow any moisture, condensation, or tarry accumulations to drain back into the gas main. In pipes where scale or tarry substances accumulate on the inside of the pipe at the orifice location, make arrangements for cleaning and draining out these accumulations. If the effective area of the connecting piping is appreciably reduced by accumulations of any such substances, the meter may become sluggish, and perhaps inaccurate.

For obvious reasons, the entire connecting piping system must be absolutely air-tight.

GENERAL

A few general rules which apply to all installations of the connecting tubing are as follows:

A most important point to remember is that all connecting tubing or piping must have a slope of at least one inch per foot, and that it must be properly supported throughout the entire length. Suitable clips or other forms of support should be provided to prevent sagging and to maintain a grade of one inch or more per foot. Across open spaces, the tubing should be supported on angle or channel iron, or it may be run in properly graded conduits if desired. Pockets formed by incorrect sloping or improper supporting of the tubing or piping will prevent correct operation of the meter and must be avoided.

The two connecting lines should be run close together but neither should come in contact with hot steam pipes. Where the connecting lines to steam and water meters are exposed to low temperatures, they should be covered to prevent freezing, and in extreme cases, it may be advisable to run a small steam or hot water line, or other heating medium between the two lines, lagging in the group thoroughly. The heating line, however, should not touch either connecting line. The same temperature should be maintained in both connecting lines. This will prevent possible meter inaccuracies caused by unequal densities of the water in these lines.

The tubing or piping must be made absolutely tight. Full lengths of tubing should be used with as few unions or fittings as possible.

FLARING COPPER AND STEEL TUBING

Special flaring tools can be supplied by the Bailey Meter Company. Copper or steel tubing should be flared by using approved flaring tools. The use of boilermaker's punches or straight iron rods for flaring usually does not produce a satisfactory job.

To make a good joint, the copper or steel tubing must be trimmed off squarely on the end and must be free of burrs. See Figure 11. Slip on the fitting nut (designated by the letter B) before starting to flare the tubing end.

Take care not to bind the nut by too much pressure on the tool. The flared end must be smooth for a good joint. Flaring should not be overdone to the extent of materially reducing the wall thickness of the tubing at the flared end. A drop of 600 W oil may be used on the joints. Do not use thread compound on compression fittings. Do not use a pipe wrench on copper or steel tubing.

TEST THE CONNECTING PIPING AND VALVE ASSEMBLY FOR LEAKS

When the connecting piping, fittings and valve assemblies have been made perfectly tight in all places except at the unions (or flanges) at H and L at the meter, where they should not yet be connected, the piping should be blown out under line pressure to make sure that it is open and clean. In blowing out the piping, the valves should be opened slowly to avoid sudden strains as the flow comes through. Then close the valves at H and L and allow the piping to fill. Any leaks that appear should be repaired at once. Make up the unions at H and L when the meter has been properly assembled and is ready for operation. See instructions covering the installation and operation of the meter.

★ ★ ★

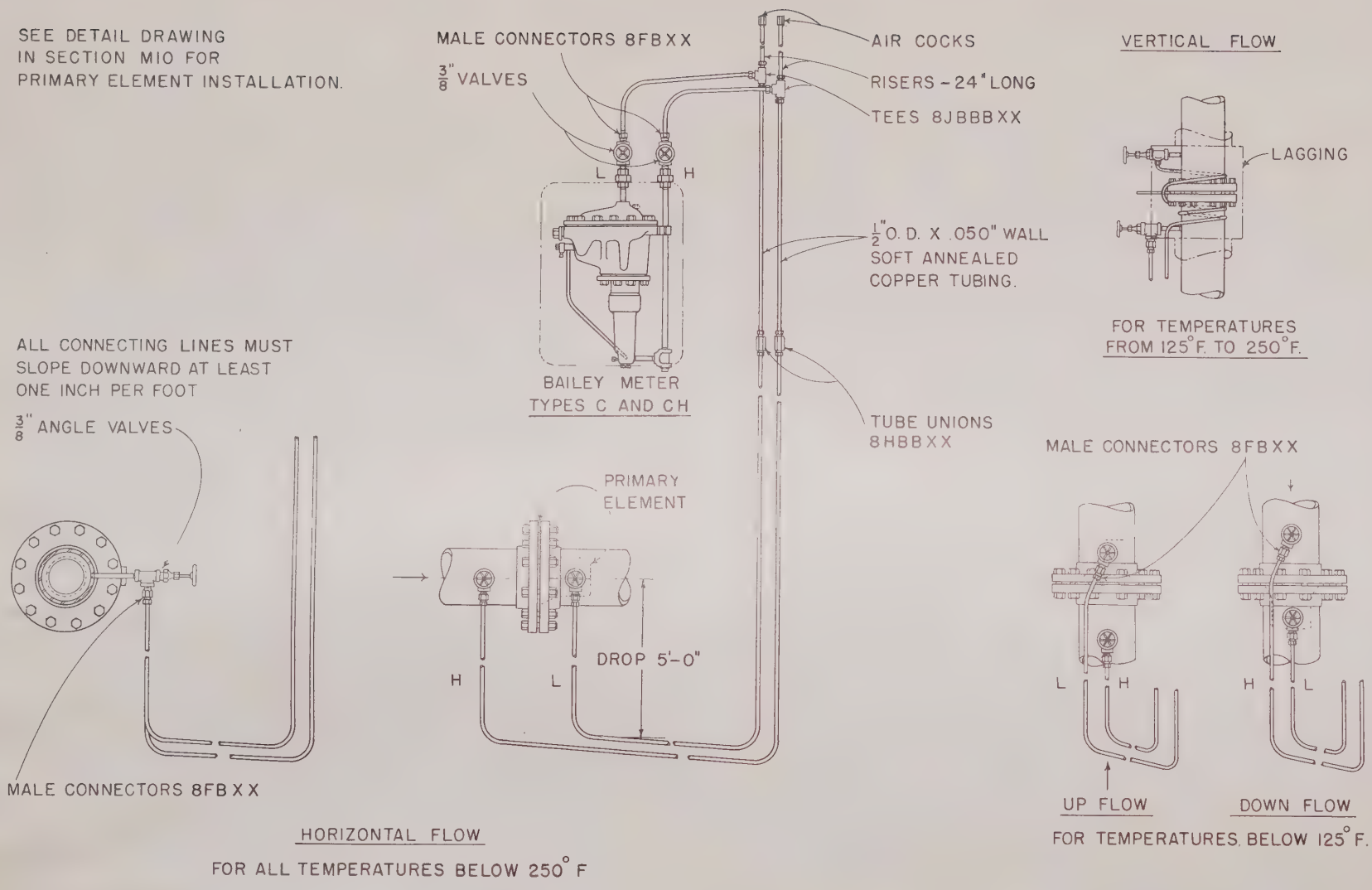


FIGURE 6 —Typical Installation of Connecting Lines for Water Flow Measurement with Meter Above Primary Element, for pressures not exceeding 800 lb. and temperatures Below 250° F.

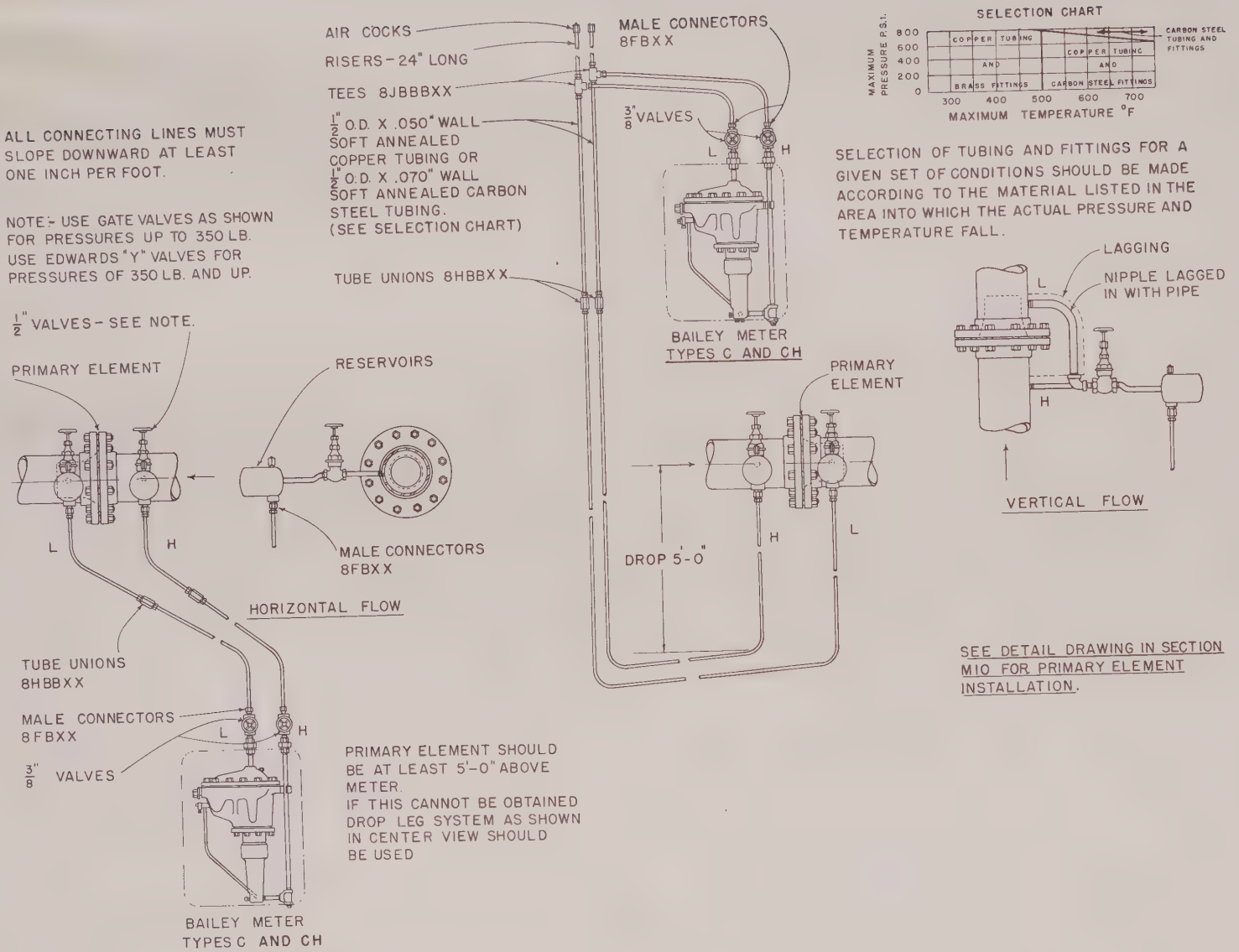

AIR COCKS
RISERS – 24" LONG
TEES 8JBBBXX
½" O.D. X .050" WALL SOFT ANNEALED COPPER TUBING OR ½" O.D. X .070" WALL SOFT ANNEALED CARBON STEEL TUBING. (SEE SELECTION CHART)
TUBE UNIONS 8HBBXX
MALE CONNECTORS 8FBXX
⅜" VALVES
L
H
BAILEY METER TYPES C AND CH
ALL CONNECTING LINES MUST SLOPE DOWNWARD AT LEAST ONE INCH PER FOOT.
NOTE:- USE GATE VALVES AS SHOWN FOR PRESSURES UP TO 350 LB. USE EDWARDS "Y" VALVES FOR PRESSURES OF 350 LB. AND UP.
½" VALVES – SEE NOTE.
PRIMARY ELEMENT
RESERVOIRS
MALE CONNECTORS 8FBXX
HORIZONTAL FLOW
TUBE UNIONS 8HBBXX
MALE CONNECTORS 8FBXX
⅜" VALVES
BAILEY METER TYPES C AND CH
PRIMARY ELEMENT SHOULD BE AT LEAST 5'-0" ABOVE METER.
IF THIS CANNOT BE OBTAINED DROP LEG SYSTEM AS SHOWN IN CENTER VIEW SHOULD BE USED
PRIMARY ELEMENT
DROP 5'-0"
SELECTION CHART
MAXIMUM PRESSURE P.S.I.
800
600
400
200
0
COPPER TUBING AND BRASS FITTINGS
COPPER TUBING AND CARBON STEEL FITTINGS
CARBON STEEL TUBING AND FITTINGS
300
400
500
600
700
MAXIMUM TEMPERATURE °F
SELECTION OF TUBING AND FITTINGS FOR A GIVEN SET OF CONDITIONS SHOULD BE MADE ACCORDING TO THE MATERIAL LISTED IN THE AREA INTO WHICH THE ACTUAL PRESSURE AND TEMPERATURE FALL.
LAGGING
NIPPLE LAGGED IN WITH PIPE
VERTICAL FLOW
SEE DETAIL DRAWING IN SECTION M10 FOR PRIMARY ELEMENT INSTALLATION.

FIGURE 7 — Typical Installation of Connecting Lines for Hot Water Flow Measurement with Meter Above or Below Primary Element for pressures from 25 lb. to 800 lb. and temperatures above 250° F.

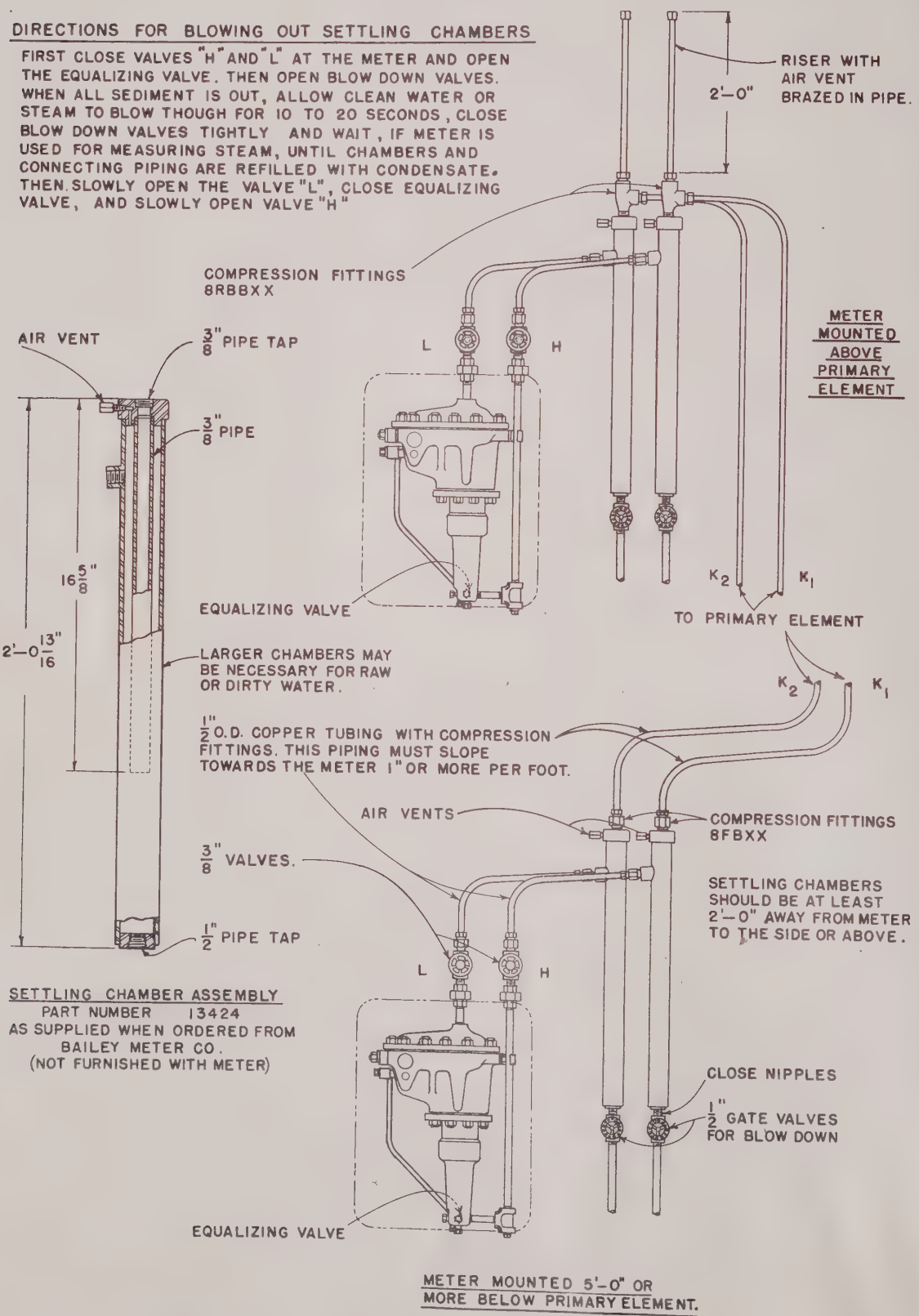

DIRECTIONS FOR BLOWING OUT SETTLING CHAMBERS
FIRST CLOSE VALVES "H" AND "L" AT THE METER AND OPEN THE EQUALIZING VALVE. THEN OPEN BLOW DOWN VALVES. WHEN ALL SEDIMENT IS OUT, ALLOW CLEAN WATER OR STEAM TO BLOW THOUGH FOR 10 TO 20 SECONDS, CLOSE BLOW DOWN VALVES TIGHTLY AND WAIT, IF METER IS USED FOR MEASURING STEAM, UNTIL CHAMBERS AND CONNECTING PIPING ARE REFILLED WITH CONDENSATE. THEN SLOWLY OPEN THE VALVE "L", CLOSE EQUALIZING VALVE, AND SLOWLY OPEN VALVE "H"
RISER WITH AIR VENT BRAZED IN PIPE.
2'-0"
COMPRESSION FITTINGS 8RBBXX
METER MOUNTED ABOVE PRIMARY ELEMENT
AIR VENT
3/8" PIPE TAP
3/8" PIPE
L
H
16 5/8"
2'-0 13/16"
EQUALIZING VALVE
LARGER CHAMBERS MAY BE NECESSARY FOR RAW OR DIRTY WATER.
K2
K1
TO PRIMARY ELEMENT
1/2" O.D. COPPER TUBING WITH COMPRESSION FITTINGS. THIS PIPING MUST SLOPE TOWARDS THE METER 1" OR MORE PER FOOT.
AIR VENTS
COMPRESSION FITTINGS 8FBXX
3/8" VALVES.
SETTLING CHAMBERS SHOULD BE AT LEAST 2'-0" AWAY FROM METER TO THE SIDE OR ABOVE.
1/2" PIPE TAP
CLOSE NIPPLES
1/2" GATE VALVES FOR BLOW DOWN
SETTLING CHAMBER ASSEMBLY
PART NUMBER 13424
AS SUPPLIED WHEN ORDERED FROM BAILEY METER CO.
(NOT FURNISHED WITH METER)
METER MOUNTED 5'-0" OR MORE BELOW PRIMARY ELEMENT.

FIGURE 8 — Typical Installation of Settling Chambers in Meter Connecting Lines.

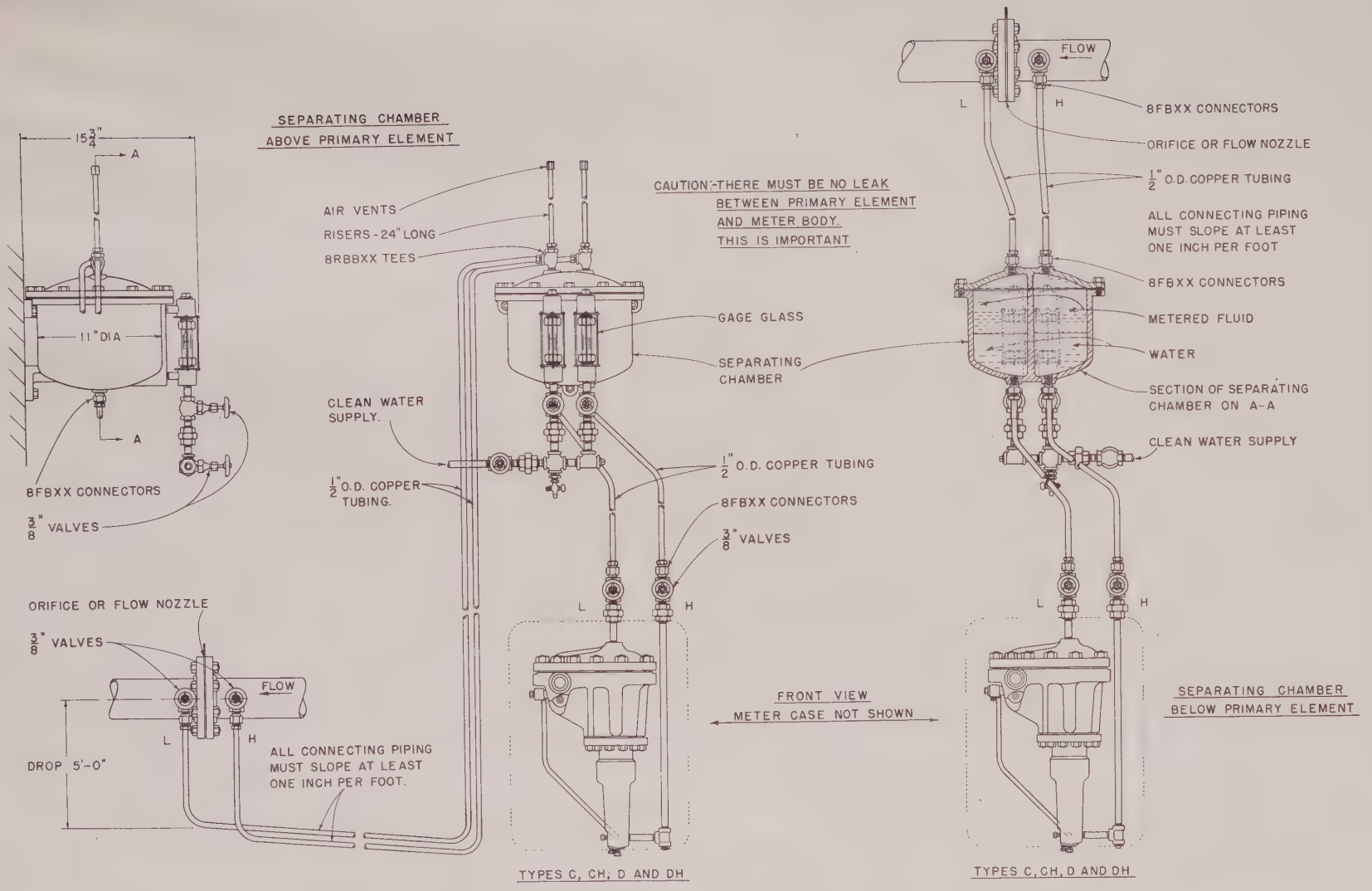
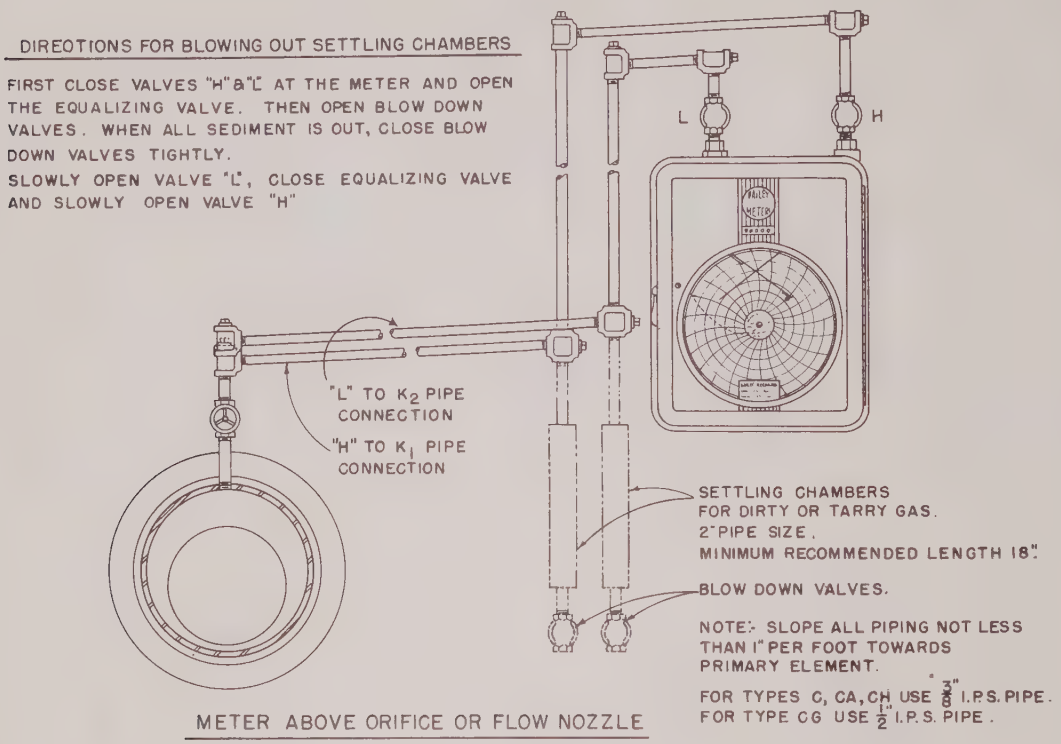


FIGURE 9 — Typical Installation of Separating Chambers for non-miscible fluids at pressures up to 600 lb.


DIRECTIONS FOR BLOWING OUT SETTLING CHAMBERS
FIRST CLOSE VALVES "H" & "L" AT THE METER AND OPEN THE EQUALIZING VALVE. THEN OPEN BLOW DOWN VALVES. WHEN ALL SEDIMENT IS OUT, CLOSE BLOW DOWN VALVES TIGHTLY.
SLOWLY OPEN VALVE "L", CLOSE EQUALIZING VALVE AND SLOWLY OPEN VALVE "H"
L
H
"L" TO K2 PIPE CONNECTION
"H" TO K1 PIPE CONNECTION
SETTLING CHAMBERS FOR DIRTY OR TARRY GAS. 2" PIPE SIZE. MINIMUM RECOMMENDED LENGTH 18".
BLOW DOWN VALVES.
NOTE:- SLOPE ALL PIPING NOT LESS THAN 1" PER FOOT TOWARDS PRIMARY ELEMENT.
FOR TYPES C, CA, CH USE 3/8" I.P.S. PIPE.
FOR TYPE CG USE 1/2" I.P.S. PIPE.
METER ABOVE ORIFICE OR FLOW NOZZLE

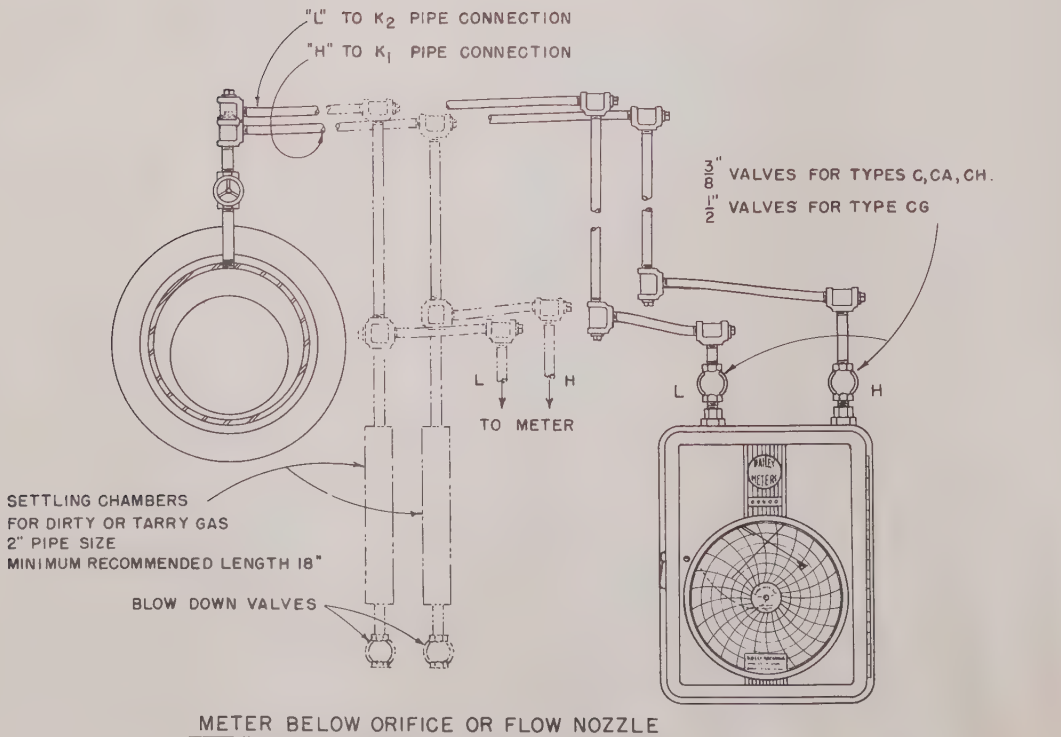
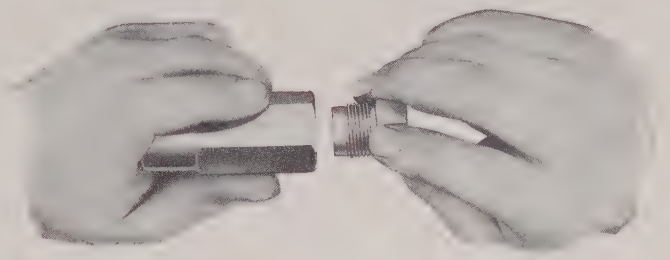

"L" TO K2 PIPE CONNECTION
"H" TO K1 PIPE CONNECTION
3/8" VALVES FOR TYPES C, CA, CH.
1/2" VALVES FOR TYPE CG
L
H
TO METER
L
H
SETTLING CHAMBERS FOR DIRTY OR TARRY GAS 2" PIPE SIZE MINIMUM RECOMMENDED LENGTH 18"
BLOW DOWN VALVES
METER ABOVE ORIFICE OR FLOW NOZZLE

FIGURE 10 — Typical Installation of Connecting Piping for Gas and Air Flow Measurement.

1. Screwing the tube nut into the hammer flaring tool preparatory to flaring the tube.



2. Inserting the copper tube to be flared into the tube nut and flaring tool.

3. Flaring the tube. In this operation, the copper tubing is held in the left hand as shown and the flaring tool is allowed to float on the end of the tube while light blows are struck with the hammer. For half-hard tube, it is necessary to strike the flaring tool somewhat harder than for soft annealed tube, although in either case the first few blows should be light.

4. Remove the flaring tool by unscrewing the tube nut after the flare has been completed.

5. Screwing the tube nut and flared copper tubing into the Dieform fitting to complete the joint.

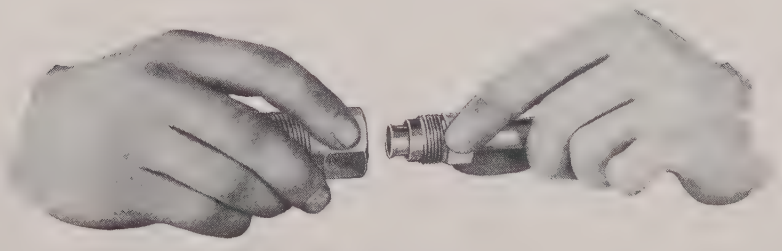


FIGURE 11 — Operations in Flaring the Tube.

PRODUCTS

BOILER METERS
BOILER WATER LEVEL RECORDERS
COAL METERS
COMBUSTION CONTROL
DRAFT CONTROLLERS
FEED WATER CONTROL
FLAME DETECTORS
FLOW CONTROLLERS
FLUID METERS
GAS ANALYZERS
LIQUID LEVEL RECORDERS
MULTI-POINTER GAGES
OPEN CHANNEL METERS
PRESSURE CONTROLLERS
PRESSURE RECORDERS
RESISTANCE THERMOMETERS
SEWAGE METERS
SMOKE RECORDERS
TELEMETERING SYSTEMS
TEMPERATURE CONTROLLERS
TEMPERATURE RECORDERS
VENTURI TUBES

★

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SEATTLE
SAN FRANCISCO

MONTREAL
TORONTO
WINNIPEG

BAILEY METER COMPANY

1050 IVANHOE ROAD • CLEVELAND 10, OHIO

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

10M-7-45

Litho. in U.S.A.

INSTRUCTIONS

SECTION M60

FOR INSTALLATION AND MAINTENANCE OF

BAILEY RECORDERS

TYPE K35

BAILEY METER COMPANY

CLEVELAND, OHIO

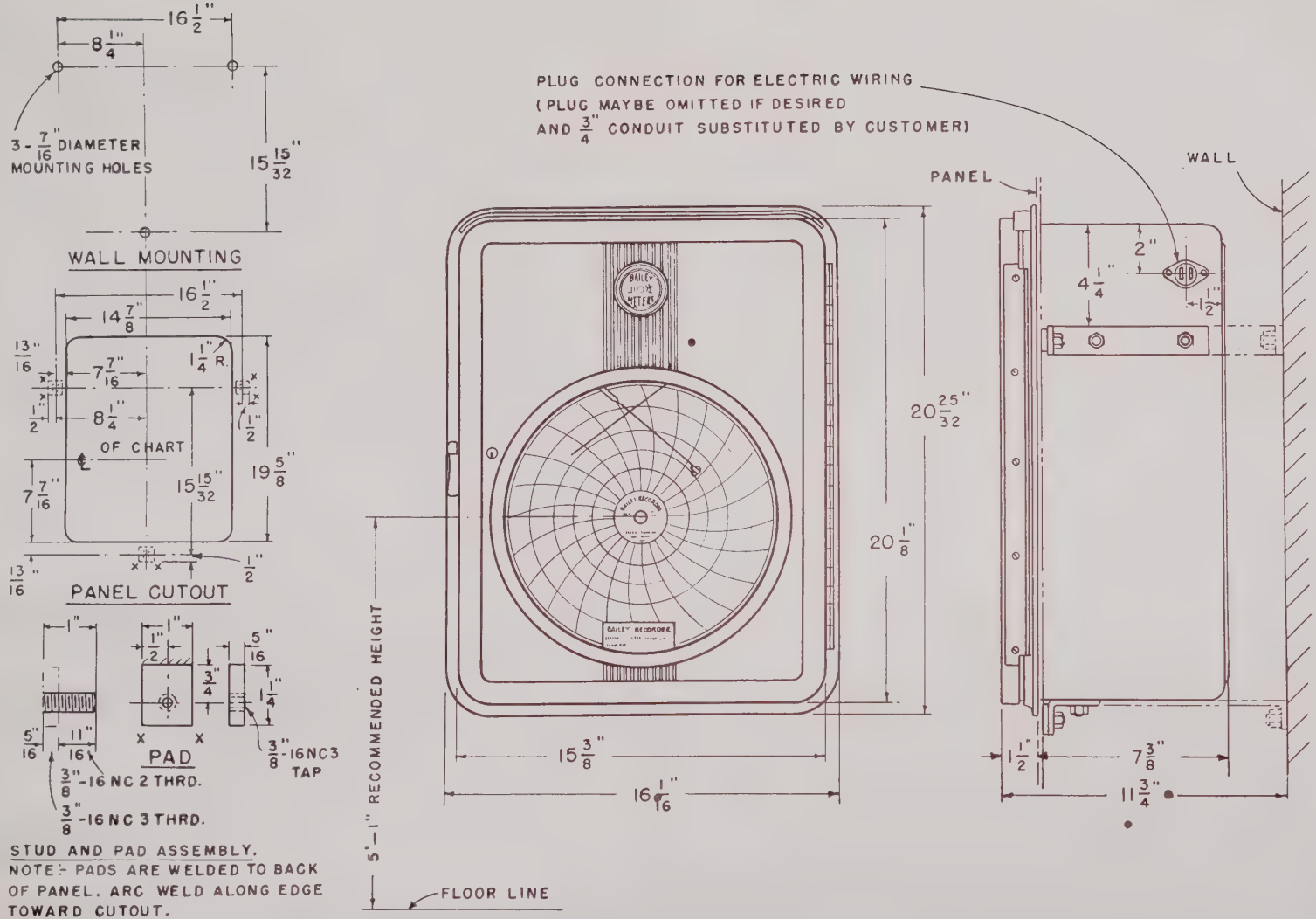


FIGURE 1—Mounting Dimensions for Bailey Recorder, Type K 35.

INSTALLATION

MOUNTING THE RECORDER

Mount the recorder in an easily accessible location, on a panel board or wall as shown in Figure 1. The center of the recorder chart should be at eye level, or approximately 5 feet 1 inch above the floor.

Brackets for mounting the recorder on a panel board are furnished as standard equipment. If, however, it is desirable to mount the recorder on a wall, brackets for this purpose can be supplied instead.

Open the door of the recorder, and by placing a spirit level on the door gasket retaining strip, level the recorder from front to back and from left to right. This is important since many of the recording elements usually installed in the Type K35 Recorder will retain the factory calibration only when mounted level. Make sure that the recorder is fastened securely.

REMOVE PACKING

While removing the strings, blocking or other packing from the inside of the recorder, take care that no parts become bent, misaligned or broken.

INSTALL RECORDING ELEMENTS

Refer to other sections of the instruction book for the proper method of installing the recording elements. Then check the assembly of the recorder to be sure that all links are properly connected and that all parts of the mechanism have been properly installed.

PLACE FOUNTAIN PEN IN PEN ARM

Fountain pens are shipped in a small flat container packed with the recorder. Place the fountain pen in the pen arm, taking care to fit the spout of the pen in the slot of the pen arm.

Make sure that the pen bears lightly on the chart. To decrease pen tension, bend the pen arm outward slightly until the pen just barely touches the chart when released.

PUT ON CORRECT CHART

The correct chart number is listed on the nameplate inside the door and is verified on the specification sheet in the instruction book. Each recording element is calibrated to operate correctly within a given range on a specific chart. Obviously, it will not record correctly on a chart where the pen motion for the designed range of the element is different.

INSPECT "TRACKING" OF PEN

In Type K35 Recorders, the pen which is made to closely follow the curvature of the time ordinate lines is in the number 2 position. The number 2 position pen is, therefore, known as the "tracking" pen. All other pens in the recorder are aligned to clear the tracking pen and each other throughout the chart range. Refer to the instructions covering the recording elements for an explanation of the procedure used in adjusting the pens.

Rotate the chart until the tracking pen is on the ordinate corresponding to the correct time, noting particularly that the correct half of the day is properly registered on the chart. Clamp the chart to the drive shaft.

INK THE PEN

Only Bailey Special Recorder Ink should be used in the pen. The pen arm is enameled the color of the ink to be used in the pen.

New fountain pens may not start inking quickly. To start the pen inking, fill with Special Recorder Ink and squeeze the top and bottom of the ink reservoir between the thumb and index finger. This will force ink through the spout. Another method of starting the flow of ink, is to fill the pen and then work a fine wire back and forth in the spout. A small bunch of these fine wires in a convenient holder, is furnished with each recorder.

Do not alter the shape of the pen spout in order to make it ink more easily.

CONNECT ELECTRICAL CIRCUITS

The chart drive, in the great majority of instances, is designed for 115 volt 60 cycle current. Ordinarily, this is connected to the power source through a plug connection on the right hand side of the case. A mating plug, which is supplied with the recorder, must be attached to external cord to bring current to the recorder. Special consideration must be given to furnishing equipment for current with a different voltage or frequency.

When the recorder contains mercury switches or other electrical devices, all connecting wiring terminates at a conveniently located terminal board secured inside the recorder case. All external wiring can be run by the customer through conduit holes in the right hand side of the case, to this terminal board.

MAINTENANCE

KEEP THE RECORDER CLEAN

No instrument can continue to give accurate results if it is neglected and allowed to get rusty and dirty. Keep the recorder door closed and locked if necessary.

IF PEN FAILS TO INK PROPERLY

Refer to instructions under the heading of "Ink the Pen", on page 3.

CHART DRIVES

Chart movements driven by Warren Motors require no oiling.

If a spring driven chart drive does not start after winding, place the small shank of the winding key on the starter shaft and turn counterclockwise. If the drive refuses to continue to run after several turns of the starter shaft, remove the chart, chart disc and drive case cover, touch the balance wheel lightly to cause it to start. Failure of the drive to start after trying these measures usually indicates that the drive needs repair and should be returned to Bailey Meter Company, Cleveland, Ohio, for repair or replacement.

Adjustment of the timing of the spring drive is accomplished in the usual manner by moving the regulating lever for faster or slower operation, as required.

Spring chart drives should be oiled every three to six months. Put a drop of light grade watch oil on the four felt pads surrounding the main shaft. Lubricate each of the other shafts sparingly. Care must be taken not to get too much oil in the drive as this will collect dirt and cause the drive to run sluggishly.

Do not wind the main spring too tightly. In some cases, a tightly wound main spring is the reason for drives refusing to start or to operate continuously.

INSTRUCTIONS

SECTION M110

FOR THE INSTALLATION AND OPERATION OF

BAILEY PRESSURE AND TEMPERATURE RECORDERS

CLASS 2, CLASS 4, AND CLASS 5H

FOR USE IN

RECORDERS, FLUID METERS, BOILER AND RATIO METERS

BAILEY METER COMPANY

CLEVELAND, OHIO

GENERAL DESCRIPTION

Pressure when applied to the inside of a flattened and curved tube will tend to straighten out the tube. This action, which has been used for many years in Bourdon tube gages, is also utilized in the helical coil of Bailey Pressure Recorders, Class 2, and Temperature Recorders, Class 4 and Class 5H.

This helical coil, which is a multiple turn Bourdon tube, as shown in Figure 1, is made of heat treated brass, stainless steel, or beryllium copper. The tube has been flattened on diametrically opposite sides and rolled into the form of a helix of approximately ten turns. One end of the coil is affixed to a base while the other is left free to move. The application of pressure inside the tube tends to unwind the coil. This motion, which is proportional to the internal pressure, is transmitted directly from the free end of the coil to a centrally pivoted drive arm. The drive arm transmits the coil motion to a recording pen, through linkage.

The helix pick-up drive arm assembly, illustrated in Figure 1, is used for suppressed ranges, because the end of the helical coil must rotate through several degrees before the recording pen rises from the bottom line of the chart.

For pressure recorders, Class 2, the helical coil is connected directly to the source of pressure.

For Temperature Recorders, Class 4 and 5H, the helical coil is connected by capillary tubing to a bulb immersed in the fluid whose temperature is to be measured. The entire system of helical coil, capillary tubing, and bulb is charged with nitrogen under a predetermined pressure, and sealed. The pressure of the constant volume of the sealed-in gas varies directly as the temperature of this gas. As the temperature of the fluid changes, the temperature of the enclosed gas changes and thus exerts corresponding changes in pressure in the helical coil.

NUMBER OF RECORDERS

All Bailey Recording Meters of the mechanically operated types are designed to permit the installation of helical coil type pressure and temperature recording elements. The number of these elements which can be installed in each meter or recorder varies with the type of meter as shown in Figure 4. From this illustration, it will be noted that while up to four pressure and/or temperature recording elements may be installed in Type K35 Recorders, a maximum of only two may be installed in the other types of meters and recorders. This is mainly because all meters other than the Type K35 already have one or two recorders for flow or level and thus have space available for only two additional recorders, as shown in Figure 2.

LOCATION DESIGNATION

The helical coil mechanism consists of three parts: the helical coil, the pen arm and pivot shaft assembly with linkage, and the pen, each of which may be located in slightly different positions in the several types of meters and recorders. In order to more easily define the position of these component parts, each part location has been given a designation letter or number. The letters A, B, C and D represent the various locations of the helical coil, and the numbers 1, 2, 3 and 4 the possible locations of the pen arm pivot shaft assembly, and of the pen. The location designation of the complete mechanism is a combination of a letter and two figures. Thus the location designation of the Pressure Recorder, Class 2, in a Type C36 Class 24 meter of the 800 psi standard is C-2-1; similarly that of the Temperature Recorder, Class 4, in the same meter, is D-3-3.

Standard location designations of the helical coil mechanism of pressure and temperature recorders in the various types of meters are tabulated in Figure 4 beneath the diagrammatic illustrations of the locations. The base of each helical coil is stamped with the location designation of the helical coil, the pen arm pivot shaft assembly, and the pen, as shown in Figure 1. Location designation, as well as other data on the pressure and temperature recorder, is also given on the specification sheet included with the meter or recorder instructions.

PRESSURE RECORDERS, CLASS 2

Since the helical coil assembly is used for both pressure and temperature recorders, the following instructions apply to the installation of the helical coil mechanisms of both types of recorders.

However, in the case of temperature recorders Class 4 and 5H, do not install the helical coil until after the bulb and capillary have been installed. Refer to instructions on pages 9 to 14 first before installing the Temperature Recorder Helical Coil.

HELICAL COIL INSTALLATION

The helical coil is designed for insertion into the specially shaped hole from the back of the

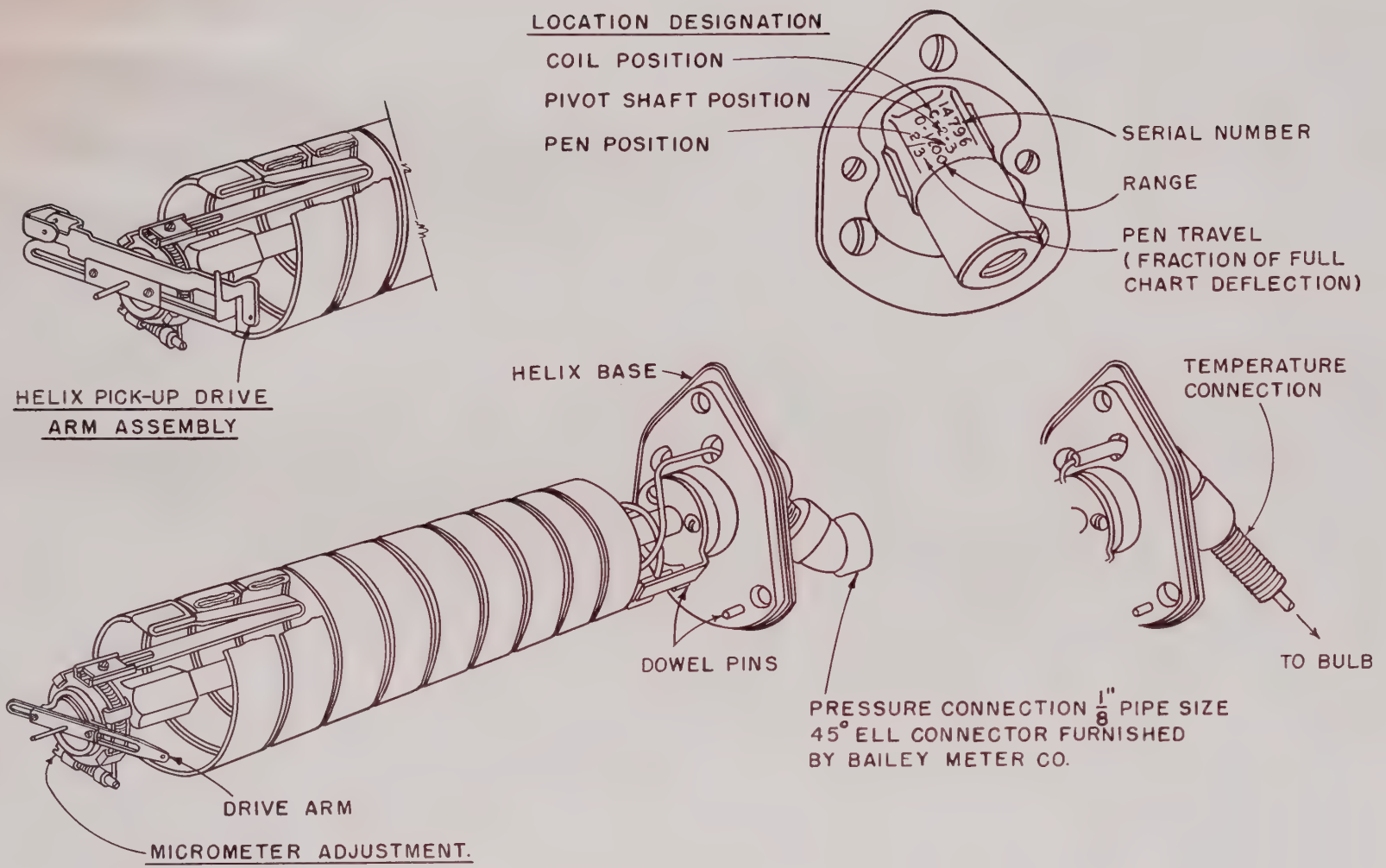


FIGURE 1—Helical Coil for Pressure and Temperature Recorders.

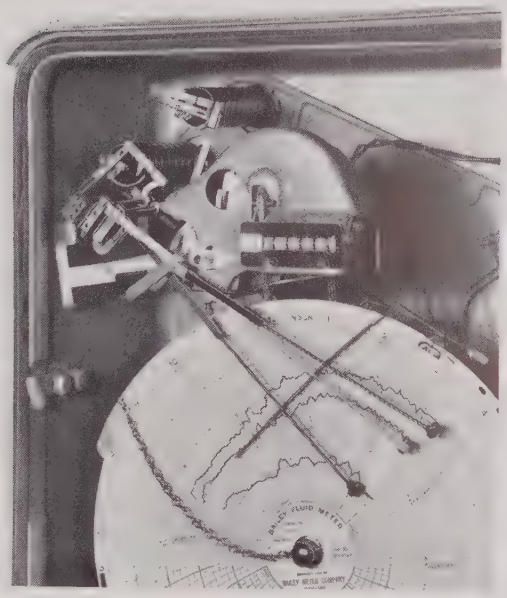


FIGURE 2—Helical Coil Type Recorders installed in a Bailey Fluid Meter.

recorder case, as shown in Figure 3. Two dowels on the helix base fit into the mounting plate inside the recorder case, thus fixing the position of the base, which is fastened to the plate by three screws.

When Pressure Recorders, Class 2, are furnished with a Recording Meter, the helical coils are shipped already installed in the meter case. When new pressure recorder elements are added to a meter already in service, and in the case of all temperature recorders, the helical coil is installed in the following manner:

Check the recorder serial number on the helical coil base to be sure that you have the correct helical coil for the meter. Refer to the specification sheet in the instruction book which lists the serial number of each auxiliary recorder to be installed in each meter.

Remove the insert and insert gasket from the back of the meter casing. Take off the top of the shipping container and remove the helical coil assembly, tilting the coil in passing the drive arm through the opening in the box to prevent bending the drive arm.

Be sure that the base and the mounting plate are free of dirt. Then insert the helical coil (see Figure 3) from the back of the meter case into the specially shaped hole corresponding to the coil position as stamped in the back of the helix base. In doing this, tilt the coil to permit entry of the drive arm without damage or misalignment. Fit the two dowel pins on the base into the mounting plate and attach the base firmly with the three screws.

INSTALL PEN ARM PIVOT SHAFT ASSEMBLY AND CONNECTING LINK

It will be noted in Figure 4, that the helical coil is connected to the pen arm by linkage attached to the pen arm pivot shaft. The shaft is pivoted on a supporting bracket having mounting steps which are designated as 1, 2, 3 and 4, from left to right. The first digit following the Coil Position letter in the stamping on the coil case, and in the tabulation on the specification sheet, designates the bracket mounting step in which the pen arm pivot shaft for the unit is to be installed. Standard bracket positions are listed in the tables on Figure 4.

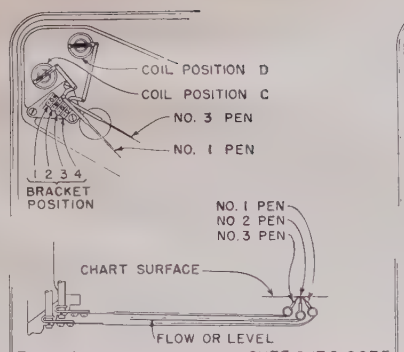
If the auxiliary recorder is furnished at the same time as the Recording Meter, the pen arm pivot shaft assembly is already in place. Detach the string on the helical coil drive arm as well as that on the pivot shaft, pen arm, and link and attach the connecting link from the pivot shaft to the small hole in the end of the drive arm.

When a new element is furnished as an addition to an existing meter, the pen arm pivot shaft assembly and the connecting link are packed in a separate container and included in the carton with the recorder element. Set the pivot shaft in place in the bearing brackets and tighten the screw in the front bracket. Test the pivot shaft to be sure that it moves freely without binding. If necessary, bend the thrust plate of the front bearing bracket. Remove the string from the coil drive arm. Then attach the connecting link from the pivot shaft to the drive arm of the helical coil.

PEN POSITION

The last digit following the Coil Position letter in the stamping on the helical coil case, indicates the position of the pen which is operated by the recording element. This same designation is shown

FIGURE 3—Insertion of the Helical Coil into Recorder Casing.

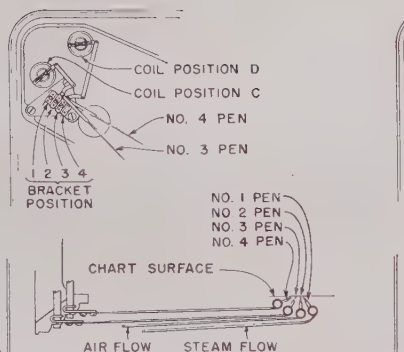


TYPE C35,C36,CA35,CA36,CH35,CH36,CG35, CG36,CU35,CU36,CS35,CS36,S35 AND S36 METERS AND LS35 LEVEL RECORDERS

0-800 P.S.I.

CLASS	COIL POSITION		OPERATES PIVOT SHAFT IN BRACKET NO.	AND PEN NO
2 4 5H	D		3	3
27 47 5H7	C		2	3
22 44 5H5H	No. 1	C	2	1
24 25H 45H	No. 2	D	3	3
227 447 5H5H7	No. 1	C	2	3
247 25H7 45H7	No. 2	D	3	4

C35, C36 800-2500 P.S.I				
2 OR 27 4 OR 47 5H OR 57	C		2	3
22	No 1	C	2	1
	No 2	D	3	3
24 25H	No 1	D	3	3
	No 2	C	2	1
25H7	No 1	D	3	4
247	No 2	C	2	3
227		C	2	3
		D	3	4



TYPE D35,D36 BOILER METERS

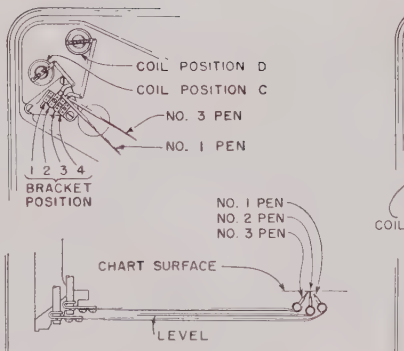
0-2500 P.S.I.

CLASS	COIL POSITION		OPERATES PIVOT SHAFT IN BRACKET NO.	AND PEN NO.
2 4 5H	C		2	3
22 24 25H	No. 1	D	3	4
44 45H 5H5H	No. 2	C	2	3

NOTE; HELICAL COILS NO. 1,2,3 AND 4 DESIGNATE THE ORDER IN WHICH THE PRESSURE RECORDER CLASS 2 AND THE TEMPERATURE RECORDER CLASS 4 AND 5H, ARE NAMED

FOR EXAMPLE IN THE CASE OF A TYPE C36, CLASS 24, COIL NO. 1 IS FOR THE CLASS 2, AND COIL NO. 2 IS FOR THE CLASS 4.

IN THE CASE OF A TYPE K35, CLASS 245H, COIL NO. 1 IS FOR THE CLASS 2, COIL NO. 2 FOR THE CLASS 4, AND COIL NO. 3 FOR THE CLASS 5H.

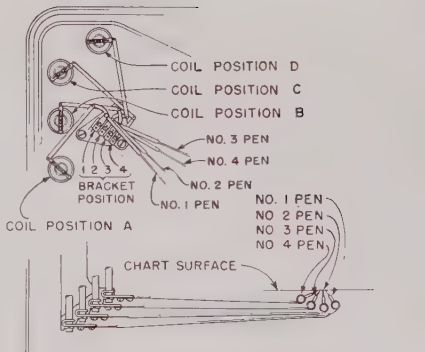


TYPE LU AND LH LEVEL RECORDERS

0-800 P.S.I.

CLASS	COIL POSITION		OPERATES PIVOT SHAFT IN BRACKET NO.	AND PEN NO.
2 OR 27 4 OR 47 5H OR 5H7	D		3	3
22 24 25H	No. 1	C	1	1
227 247 25H7				
44 45H 5H5H	No. 2	D	3	3
447 45H7 5H5H7				

LH 35 800-2500 PSI				
2 OR 27 4 OR 47 5H OR 5H7	C		1	1
22 24 25H	No. 1	D	3	3
247 25H7	No. 2	C	1	1
227	No 1	C	1	1
	No 2	D	3	3



TYPE K35 RECORDERS

CLASS	COIL POSITION		OPERATES PIVOT SHAFT IN BRACKET NO.	AND PEN NO.
2 4 5H	D		2	2
22 44 5H5H	No. 1	D	2	2
24 45H 25H	No 2	B	3	3
222 444 5H5H5H	No. 1	A	1	1
224 445H 225H	No 2	D	2	2
45H5H 244 245H 25H5H	No 3	B	3	3
2222 4444 5H5H5H5H	No. 1	A	1	1
2224 4445H 2225H	No 2	D	2	2
245H5H 445H5H 2244 2245H	No 3	B	3	3
25H5H5H 45H5H5H 225H5H 2444 2445H	No 4	C	4	4

FIGURE 4—Location of Chart for Helical Coil Type Pressure and Temperature Recorders.

on the specification sheet. Standard pen positions are also shown on Figure 4.

PLACE FOUNTAIN PEN IN PEN ARM

Fountain pens are shipped in a small, flat container packed with the recorder. Place the fountain pen in the pen arm, taking care to fit the spout of the pen in the slot of the pen arm.

Make sure that the pen bears lightly on the chart. To decrease the pen tension, bend the pen arm outward slightly until the pen barely touches the chart when released.

PUT ON CORRECT CHART

Each helical coil type recorder was calibrated at the factory to operate correctly on the pressure or temperature range on the specified chart. Obviously, it will not record correctly on a chart where the pen motion for the designed pressure or temperature range is different. The correct chart number is listed on the Recorder nameplate inside the door, and is verified on the specification sheet in the instruction book.

INSPECT "TRACKING" OF PEN

In all meters, the pen which is made to closely follow the curvature of the time ordinate lines on the chart is known as the "tracking" pen. The other recording pens are aligned to clear the tracking pen and each other. The tracking pen is set on the time ordinate on the chart corresponding to the correct time. As shown in Figure 4, number 2 recording pen in all types of meters except Boiler Meters and Ratio Meters, is the tracking pen. In Boiler Meters and Ratio Meters the tracking pen is the number 1 pen. It will be noted that in Fluid Meters, Boiler Meters, Ratio Meters and Level Recorders, the tracking pen is the one that records flow or level.

To inspect the alignment of the tracking pen: With the pen on the zero line, rotate the chart until one of the ordinate lines is exactly under the tracking pen. Move the mechanism which actuates the tracking pen, moving the pen to the top line of the chart. If the pen is not on the ordinate line at the upper chart graduation, bend the end loop of the pen arm a small amount, moving the pen point in the direction away from the ordinate line. Lower the pen to zero and reset on the ordinate line. Repeat the entire operation until the pen is on the ordinate line at both the lowest and highest points of travel.

All other pens in the recorder should then be adjusted to clear the tracking pen and each other by 1/32 inch at the point on the chart where the distance between the pen points is a minimum. If the distance is found to be greater or less than this, bend the end loop of the pen arm until there is 1/32 inch clearance between adjacent pen points.

Rotate the chart until the tracking pen is on the ordinate corresponding to the correct time, noting particularly that the correct half of the day is properly registered on the chart. Clamp the chart to the driving spindle.

INK THE PEN

Only Bailey Special Recorder Ink should be used in the pen. The pen arm is enameled the color of the ink to be used in the pen.

New fountain pens may not start inking quickly. To start the pen inking, fill with Special Recorder Ink and squeeze the top and bottom of the ink reservoir between the thumb and the index finger. This will force ink through the spout. Another method of starting the flow of ink is to fill the pen and then work a fine wire back and forth in the spout. A small bunch of these fine wires in a convenient holder is furnished with each meter.

Do not alter the shape of the pen spout in order to make it ink more easily.

CONNECTING PIPING

When the Pressure Recorder, Class 2, is to be installed as an auxiliary recorder in a Fluid Meter, Boiler Meter, or Type LH35 Level Recorder, to measure the pressure of the metered fluid, it may be connected directly to Pipe H of the meter which is subject to line pressure. This connection is made with a special piece of tubing which is furnished together with the necessary fittings, as illustrated in Figure 5.

When piping the pressure recorder to a meter already in service, shut off the meter and open the equalizing valve. In meters for steam and liquids, refill the meter with water and vent the air out of the meter before placing it back into service.

When a Pressure Recorder, Class 2, is furnished with a Type K35 Recorder, or in instances where the connection is to be made directly to a vessel under pressure, the installation should be made as shown in Figure 6. You will note that a $\frac{3}{8}$-inch nipple or larger should be inserted into the pressure vessel and followed by a shut-off valve of the same pressure standard as the rest of the piping in the system. Either $\frac{1}{2}$-inch O.D. copper or steel tubing or $\frac{3}{8}$-inch ips steel or brass pipe may be used to connect the pressure recorder to the pressure source. It is highly advisable, however, to use a short length of $\frac{1}{4}$-inch O.D. tubing with compression fittings from the recorder to the valve at the recorder end of the connecting piping, to provide sufficient flexibility in the piping system. It is advisable also to arrange for periodic blowdowns of the connecting

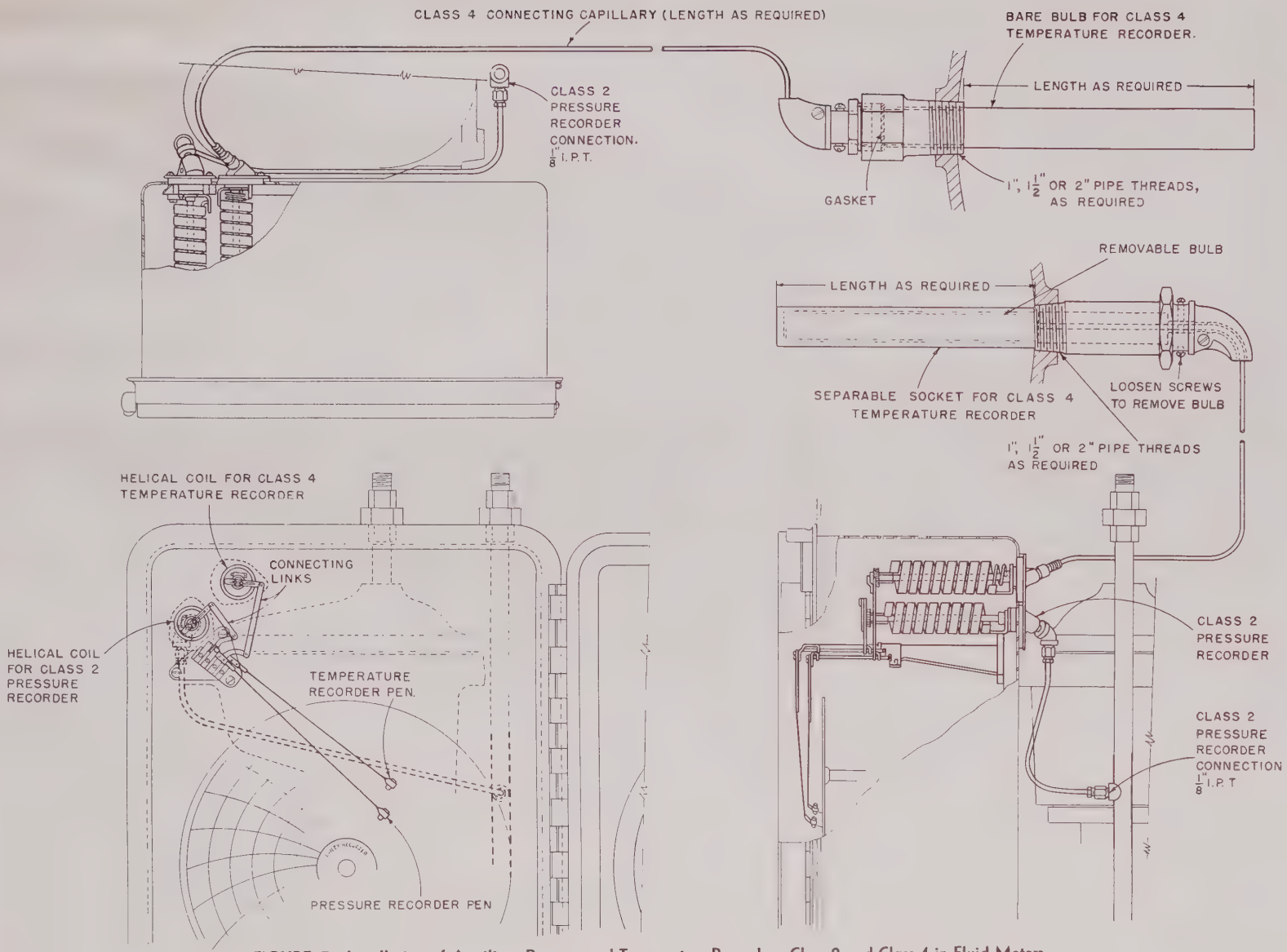

CLASS 4 CONNECTING CAPILLARY (LENGTH AS REQUIRED)
BARE BULB FOR CLASS 4 TEMPERATURE RECORDER.
LENGTH AS REQUIRED
CLASS 2 PRESSURE RECORDER CONNECTION. 1/8" I.P.T.
GASKET
1", 1 1/2" OR 2" PIPE THREADS, AS REQUIRED
REMOVABLE BULB
LENGTH AS REQUIRED
SEPARABLE SOCKET FOR CLASS 4 TEMPERATURE RECORDER
LOOSEN SCREWS TO REMOVE BULB
1", 1 1/2" OR 2" PIPE THREADS AS REQUIRED
HELICAL COIL FOR CLASS 4 TEMPERATURE RECORDER
CONNECTING LINKS
HELICAL COIL FOR CLASS 2 PRESSURE RECORDER
TEMPERATURE RECORDER PEN.
PRESSURE RECORDER PEN
CLASS 2 PRESSURE RECORDER
CLASS 2 PRESSURE RECORDER CONNECTION 1/8" I.P.T

FIGURE 5—Installation of Auxiliary Pressure and Temperature Recorders, Class 2 and Class 4 in Fluid Meters.

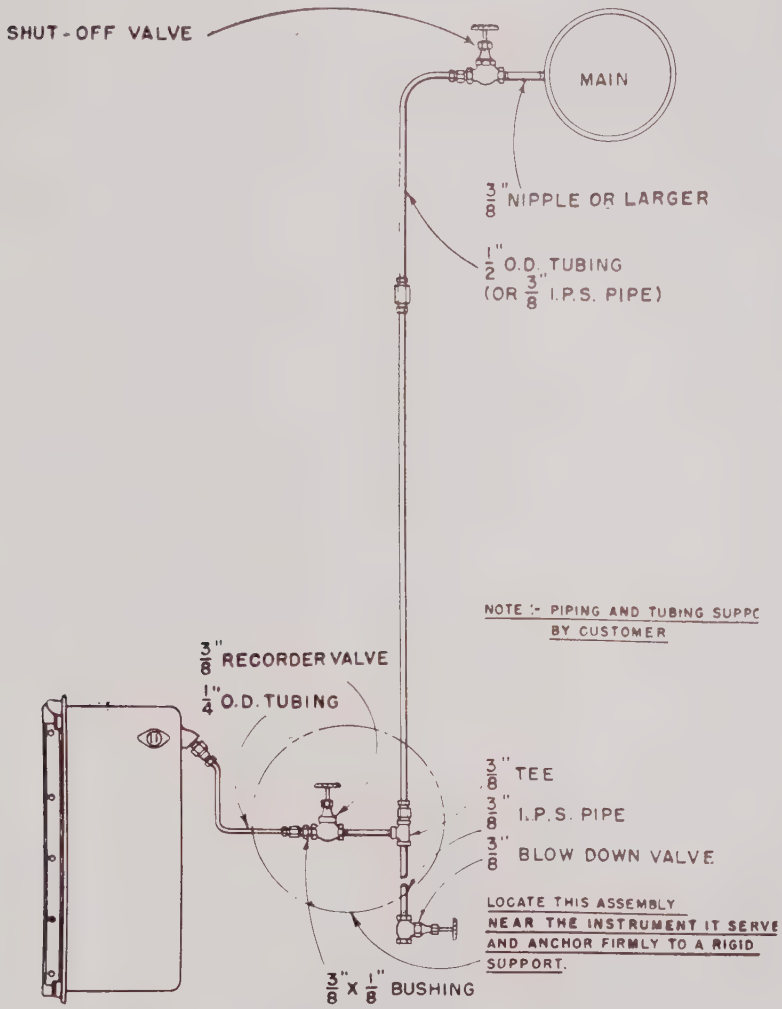


FIGURE 6—Typical Installation of the Connecting Piping for a Pressure Recorder, Class 2.

piping by the installation of a blow-down valve as shown in Figure 6.

The recorder valve and the blowdown valve should be located near the recorder for greater operating convenience.

OPERATION

When the pressure is turned on in the vessel, first close the recorder valve and blowdown valve and open the shut-off valve at the vessel. Blow down the connecting piping to be sure that it is clear. Close the blowdown valve and allow the connecting piping to fill with the line fluid or with condensate and become cool. Check for leaks.

ADJUSTMENT

The micrometer adjustment provided on the helical coil may be used to correct the recording pen for small errors in reading. To lower the recording pen, insert the blade of a small screw driver in the large slot of the micrometer adjustment and turn clockwise. To raise the pen, turn the adjustment counterclockwise. Refer to Figure 1.

It must be remembered that when steam or water pressure is being measured, the recorder will register the pressure in the vessel plus the pressure of the head of water above the recorder. The pressure of the head of water can be calculated and the position of the recording pen can be readjusted so that the recorder will show only the pressure in the vessel.

VERIFY PRESSURE RECORDER ACCURACY

The accuracy of the pressure recorder can be checked by a dead weight tester or by connecting it in parallel to a standard test gage.

In the event that the readings of the pressure recorder pen do not agree with the actual pressure as determined by the dead weight tester or by the standard test gage, the pens can be reset to agree with the calibrated pressure by means of the micrometer adjustment beneath the drive arm of the helical coil as shown in Figure 1.

Do not attempt to operate a pressure recorder beyond the range stamped on the helical coil base and listed on the specification sheet.

TEMPERATURE RECORDERS CLASS 4 AND CLASS 5H

The Helical Coil Mechanism is utilized as the recording element of the Temperature Recorders, Class 4 and Class 5H. The instructions covering the installation of this mechanism, included on pages 2 to 6, may therefore be considered an essential part of the following instructions which cover the istallation, operation and calibration of the Temperature Recorders, Class 4 and Class 5H.

Please note, however, that the bulb and connecting capillary must be installed before the Helical Coil.

SHIPMENT

The Class 4 and Class 5H Temperature Recorders are shipped in a box specially constructed to protect the helical coil, the capillary tubing and the bulb, as shown in Figure 7. The mounting board to which the unit is attached should first be taken out of the box. Then detach the bulb, capillary tubing, and the box containing the helical coil from the mounting board. Do not remove the helical coil from the small box until the bulb and capillary are installed.

INSTALL CLASS 4 TEMPERATURE RECORDER BULBS

A. *Types*

Class 4 Temperature Recorder bulbs are designed for installation in pipe lines or vessels containing steam, air or gas, water or other liquids. There are two general types of Class 4 bulbs, as shown in Figure 5. The most commonly used type is that designed to fit into a separable socket which permits removal of the bulb without shutting off the flow through the pipe. The Bailey Separable Socket has either 1-inch, 1½-inch or 2-inch pipe threads for screwing it into the pipe, or it can be supplied in these pipe sizes for welding to the pipe wall. The second type of bulb, known as the bare bulb, fits directly into the pipe without the use of a separable socket, thus coming in direct contact with the fluid whose temperature is being measured. The bare bulb type is often equipped with a flange for attaching to a flanged nipple large enough to receive the bulb.

Other types of bulbs may be furnished if required. In such cases, these instructions will be supplemented with a drawing illustrating the bulb and/or socket supplied.

B. *Location*

The bulb or separable socket must be installed in a location where it will not interfere in any way with the accurate measurement of the flow. That is, it should not be installed nearer than 15 pipe diameters on the inlet side of an orifice, flow nozzle, or venturi tube, nor nearer than 6 pipe diameters on the outlet side. The bulb should preferably be installed on the outlet side of the orifice, flow nozzle, or other primary element.

The location selected should be as near to the recorder case as possible in order that the length of connecting capillary be kept to a minimum.

C. *Installation*

The temperature recorder bulb, Class 4, must be installed in a position where the *entire length of the gas-filled section of the bulb* is in contact with the flowing fluid. The accuracy and sensitivity of the unit will be affected if any portion of the nitrogen filled bulb is installed in a pocket through which flow is not continuously circulating.

It is usually most convenient to install the bulb and separable socket at right angles to the direction of flow. When the length of the gas-filled section of the bulb or of the socket is greater than the internal pipe diameter, it will be necessary to install the bulb parallel with the direction of the flow, in accordance with either of two methods as shown in Figure 8.

D. *Support the Bulb*

When the bare bulb or the separable socket is 12 inches or longer from the point where it is secured to the pipe or from the retaining flange, to the end inserted in the pipe, it will be necessary to provide additional support for the section within the pipe in order to prevent possible failure due to vibration. Such support can be arranged as follows:

1. For installations where the bulb or socket parallels the pipe, use three pins equally spaced circumferentially, extending into the pipe and touching the bulb or socket. These pins can be welded to the outside surface of the pipe as shown in Scheme 1 of Figure 8.

2. If preferred, a specially designed spider can be fabricated with a center holding ring and three radial fins, as shown in Scheme 2,

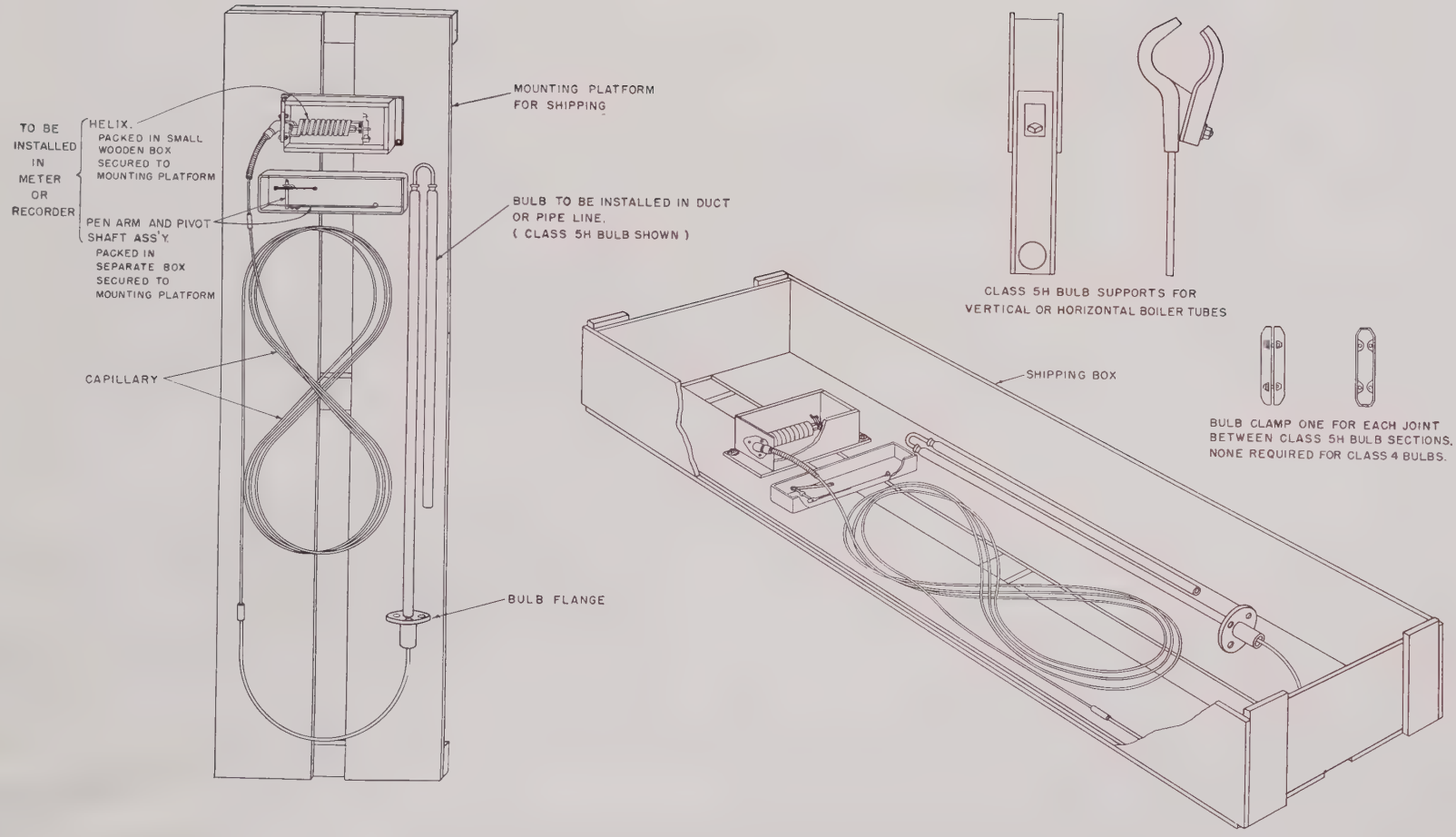

TO BE INSTALLED IN METER OR RECORDER
HELIX. PACKED IN SMALL WOODEN BOX SECURED TO MOUNTING PLATFORM
PEN ARM AND PIVOT SHAFT ASS'Y. PACKED IN SEPARATE BOX SECURED TO MOUNTING PLATFORM
CAPILLARY
MOUNTING PLATFORM FOR SHIPPING
BULB TO BE INSTALLED IN DUCT OR PIPE LINE. (CLASS 5H BULB SHOWN)
BULB FLANGE
CLASS 5H BULB SUPPORTS FOR VERTICAL OR HORIZONTAL BOILER TUBES
SHIPPING BOX
BULB CLAMP ONE FOR EACH JOINT BETWEEN CLASS 5H BULB SECTIONS. NONE REQUIRED FOR CLASS 4 BULBS.

FIGURE 7—Shipping Container of the Class 5H Temperature Recording Element.

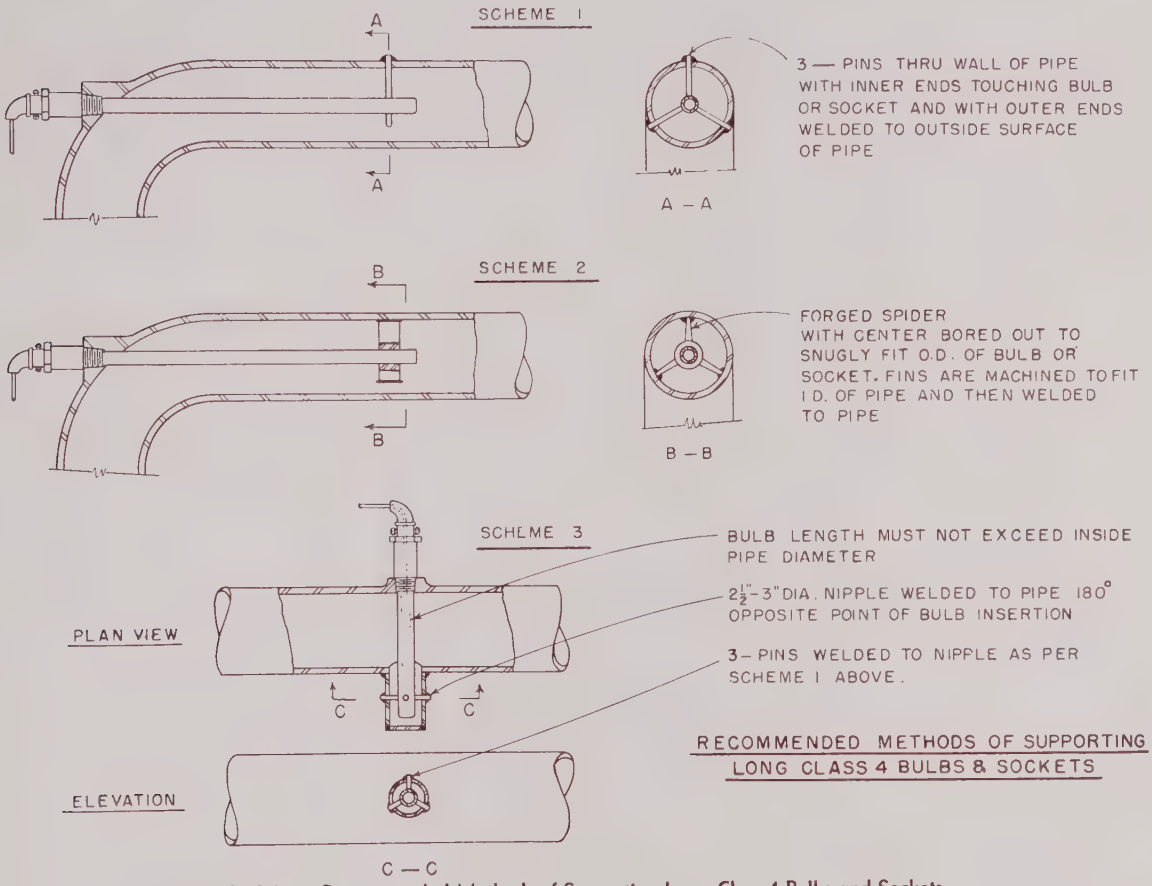

SCHEME 1
A
A
3 — PINS THRU WALL OF PIPE WITH INNER ENDS TOUCHING BULB OR SOCKET AND WITH OUTER ENDS WELDED TO OUTSIDE SURFACE OF PIPE
A — A
SCHEME 2
B
B
FORGED SPIDER WITH CENTER BORED OUT TO SNUGLY FIT O.D. OF BULB OR SOCKET. FINS ARE MACHINED TO FIT I.D. OF PIPE AND THEN WELDED TO PIPE
B — B
SCHEME 3
BULB LENGTH MUST NOT EXCEED INSIDE PIPE DIAMETER
2½"-3" DIA. NIPPLE WELDED TO PIPE 180° OPPOSITE POINT OF BULB INSERTION
3 — PINS WELDED TO NIPPLE AS PER SCHEME 1 ABOVE.
PLAN VIEW
C
C
ELEVATION
C — C
RECOMMENDED METHODS OF SUPPORTING LONG CLASS 4 BULBS & SOCKETS

FIGURE 8—Recommended Methods of Supporting Long Class 4 Bulbs and Sockets.

Figure 8. The ring is bored to fit the outside diameter of the bulb or socket and the outside tips of the fins are cut off to fit the internal pipe diameter. The spider must then be attached by holding pins through the wall of the pipe or by internal welding.

3. Where the long bulb or socket is installed at right angles to the pipe axis and where the active bulb length is equal to or less than the internal pipe diameter, an extra long socket that will project into a nipple welded to the opposite side of the pipe should be provided. Three centering pins, as shown in Scheme 3 of Figure 8, or a centering collar can be used in the nipple to firmly anchor the socket end.

Undoubtedly other methods can be employed in properly supporting these bulbs or sockets, but regardless of the scheme used, *the bulb must be supported adequately to prevent vibration.*

It will be noted in Scheme 3 that the separable socket must be somewhat longer than the bulb itself in order that the entire length of the bulb will be in the fluid stream, and that no portion of the bulb extends into the nipple welded to the bottom or side of the pipe. The following table defines the lengths of separable socket required for various sizes of pipe when it is necessary to anchor the bulb and the installation is made in accordance with Scheme 3:

Size of Pipe	*Length of Socket*
6″	9″
8-10″	12″
12″	15″
15″	18″
18″	21″

INSTALL CLASS 5H TEMPERATURE RECORDER BULBS

A. *Types*

Class 5H Recorders are utilized to measure the temperature of air and gases in large ducts or boiler passages or near atmospheric pressure. The bulbs of these recorders are made of ¾-inch O.D. steel tubing in lengths up to four feet, or in sectionalized form when in excess of four feet.

As will be noted from Figure 9, these bulbs can be furnished either with a bolting flange and with short dead (inactive) sections at each end, for installation in steel ducts, or with a wall flange and a longer dead section for installation through boiler setting walls.

In either case, the bulb sections are so proportioned as to span the entire passage or duct in order to obtain an average temperature.

B. *Location*

If a metering orifice or Venturi Section is used in the duct, the bulb should not be located closer to the primary element than 15 duct diameters on the inlet of the orifice nor less than 6 diameters on the outlet side. It is preferable that the bulb be placed on the outlet side of the orifice.

C. *Installation*

The bulb should be placed in the active flow stream of the duct. Be careful to avoid any dead pockets through which the air or gases do not continuously sweep.

Details of the procedure for installing a long sectionalized bulb in a boiler setting, or in any duct where the space between the duct and a wall or other structure is restricted, are shown in Figure 10.

D. *Support the Bulb*

When the bulb is installed in a boiler setting, supports for clamping the bulb to the tubes are furnished by Bailey Meter Company, provided the tubes are at least 2½ inches in diameter. In cases where the bulb is installed in an air or gas duct, special supports are usually required to securely fasten and support the bulb against sagging and vibration. These supports must be furnished by the customer.

INSTALL CAPILLARY TUBING

Afer the Class 4 or Class 5H bulb has been installed, the capillary should be carefully uncoiled and run as directly as possible between the recorder and temperature source. Avoid kinks and sharp bends in the capillary tubing, since these may restrict or close the small opening in the tubing and affect the operation of the unit. The tubing should be out of the way of plant maintenance operations and should be supported by clips, moulding, channels or conduits at frequent intervals to afford maximum protection against accidental damage. An extension of the capillary tubing used for charging the system with nitrogen is wound around the helical coil center post beneath the helical coil. This small capillary, if handled at all, must be manipulated very carefully to avoid any possible breakage since this would allow the nitrogen gas to escape and render the recorder useless.

INSTALL HELICAL COIL

Refer to instructions on pages 2 to 6 covering installation of Helical Coil mechanism.

VERIFY CALIBRATION

If the boiling point of water is within chart range of a Class 4 Temperature Recorder, the accuracy may be verified by placing the bulb in a bucket or tank of boiling water and comparing the temperature reading with that of a mercury thermometer of known accuracy. At atmospheric pressure of 29.92 inches of mercury, the boiling point of water is 212° F., but this temperature decreases with lower atmospheric pressures.

For temperatures higher than the boiling point of water, the Class 4 bulb may be immersed in an oil bath and the readings of the recorder again compared with a thermometer of known accuracy. The oil should be thoroughly agitated to be sure that a uniform temperature exists throughout the oil bath during the check. The accuracy of the Class 5H Recorder may be checked from time to time by taking a series of readings along the whole width of the duct with an armored mercurial thermometer. The average of the series should check closely with the recorded temperature. Care must be taken, however, to be sure that an average temperature is obtained to use as a check on the recorder. Readings at one or two points along a 20 foot width of duct for example will by no means represent an average temperature.

Do not attempt to operate a temperature recorder beyond the range stamped on the back of the helical coil and as designated on the specification sheets.

In case the readings of the Temperature Recorder Class 4 or Class 5H do not check the temperature indicated by the thermometer over several points within the range of the recorder, small discrepancies in calibration may be corrected by the use of the micrometer adjustment on the helical coil. To lower the recording pen, insert the blade of a small screw driver in the larger slot of the worm gear adjustment and turn clockwise. To raise the pen, turn the adjustment counterclockwise.

If the recorder reads correctly at one temperature and is considerably in error, either high or low, at another temperature, it may be necessary to return the unit to the factory for recalibration.

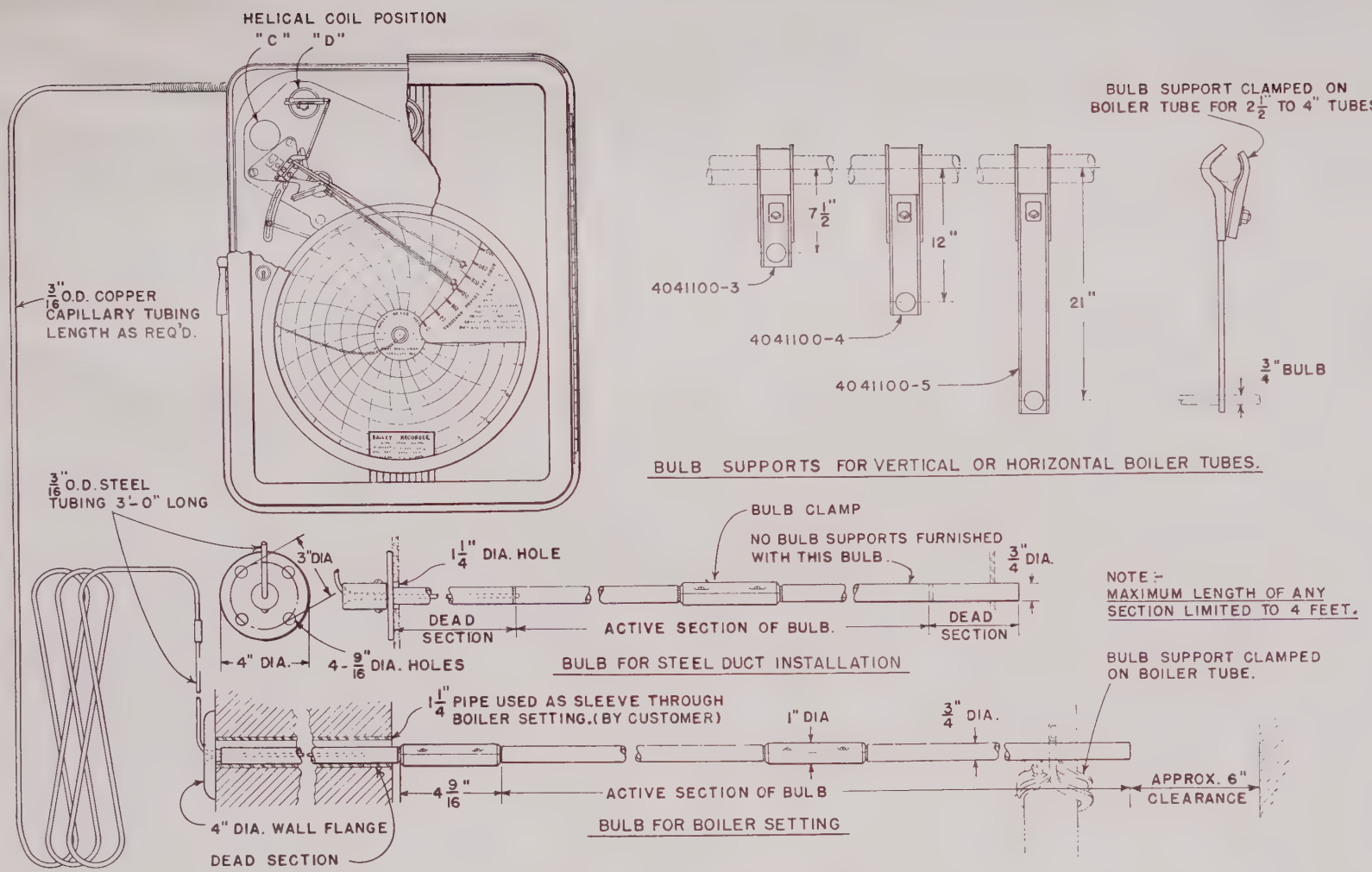


FIGURE 9—Class 5H Temperature Recorder.

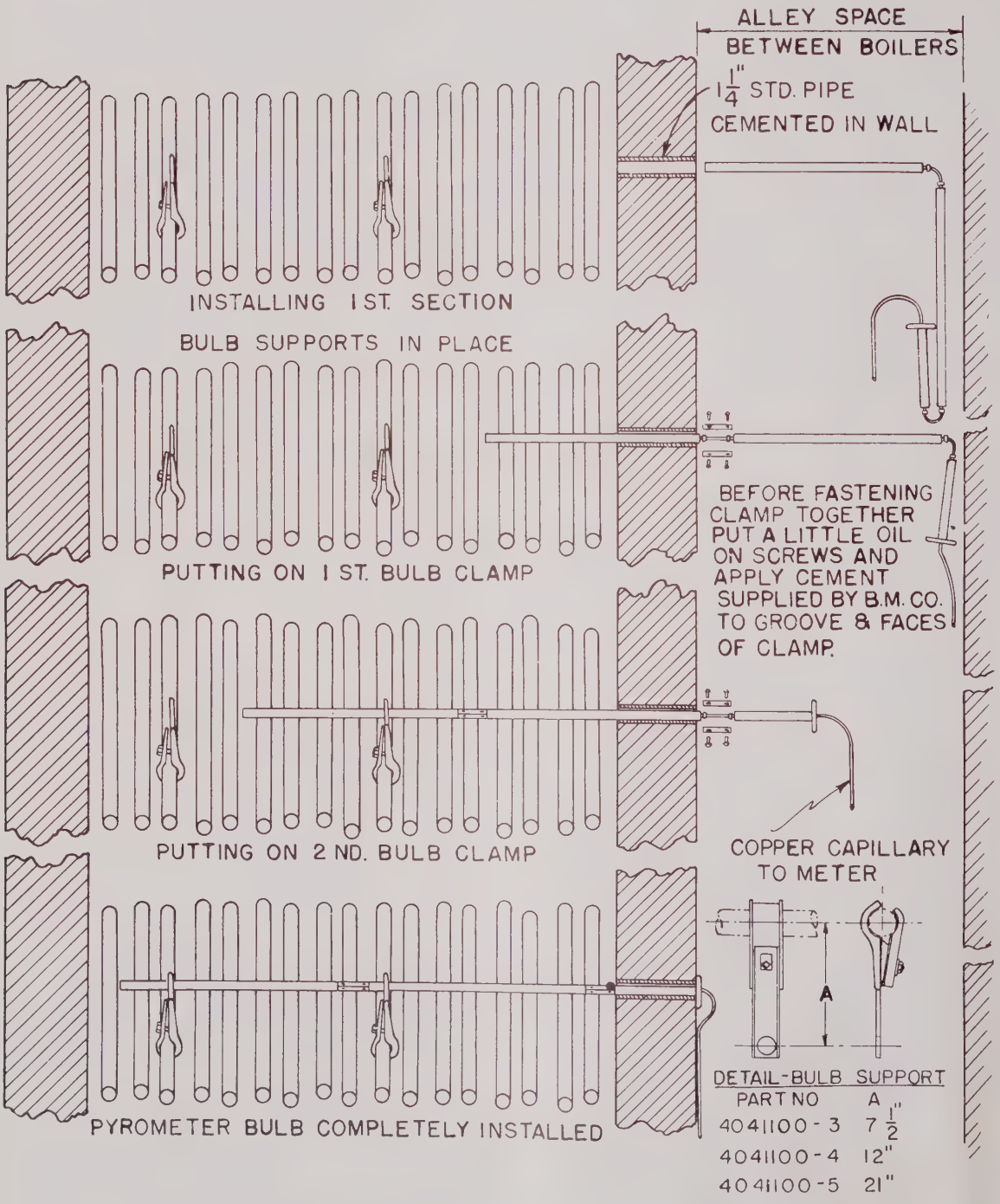

ALLEY SPACE
BETWEEN BOILERS
1 1/4" STD. PIPE
CEMENTED IN WALL
INSTALLING 1ST. SECTION
BULB SUPPORTS IN PLACE
PUTTING ON 1 ST. BULB CLAMP
BEFORE FASTENING CLAMP TOGETHER PUT A LITTLE OIL ON SCREWS AND APPLY CEMENT SUPPLIED BY B.M. CO. TO GROOVE & FACES OF CLAMP.
PUTTING ON 2 ND. BULB CLAMP
COPPER CAPILLARY TO METER
A
PYROMETER BULB COMPLETELY INSTALLED
DETAIL-BULB SUPPORT
PART NO A
4041100-3 7 1/2"
4041100-4 12"
4041100-5 21"

FIGURE 10—Installation of Class 5H Flue Gas Temperature Recorder Bulb where Alley Space is Limited.

FOR THE INSTALLATION AND MAINTENANCE OF

BAILEY ELECTRONIC TELEMETER CIRCUIT

APPLICATION AND FUNCTION

The Bailey Electronic Telemeter is a system for transmitting position. Any factor or quantity which can be made to move a small transformer core may be indicated or recorded on a distant receiver. Common applications are for the transmission of flow, level, pressure and mechanical position. Calculating systems may also be derived to totalize, divide, multiply or subtract various quantities and groups of quantities.

The simple electronic telemeter illustrated by Figure 1 consists of three basic elements (1) a transmitter which is actuated by a Ledoux bell, Bourdon tube, float, bellows, or other device depending upon the factor to be measured; (2) a receiver which may indicate, record and integrate the transmitted quantity at some remote point; and (3) an electron tube amplifier and motor control unit.

1. The transmitter consists of a transformer with a movable core which is positioned by the measuring device. In the case of Fluid Meters and Level Recorders where the measuring device is often designed to operate under pressure, the transformer core may be housed inside the same pressure casing, thereby eliminating the necessity for transfer of mechanical motion through a pressure tight bearing.

2. The receiver is a calibrated slidewire resistance unit which is positioned relative to its contact by a reversing motor. This unit operates the indicating, recording and integrating mechanisms of the receiver by means of a cam and roller arm.

3. The amplifier and motor control detects unbalance in the electrical bridge formed by the transformer coils at the transmitter and the resistance on each side of the slidewire contact at the receiver. It also provides power for operation of the reversing motor which drives the slidewire unit to balance the bridge.

THEORY OF OPERATION

Referring to Figure 1, it will be noted that the transmitter is basically a movable core transformer having a primary winding which supplies the exciting magnetic flux and two secondary windings placed concentric with the primary winding as shown in Figure 2. The position of the movable core determines the magnetic flux linkage between the primary winding and the second windings as illustrated by Parts a, b and c of Figure 2. The voltage induced in each of the secondary windings depends on the magnetic flux linking it from the primary. Since these flux linkages are determined by the position of the movable core, the voltage induced in each secondary coil is proportional to the displacement of the core from the center position.

An electrical bridge is formed by the two secondary coils at the transmitter, and the resistance on each side of the slidewire contact at the receiver. When the voltage ratio $\frac{E2}{E1}$ is equal to the ratio of the voltage drops in the resistances on each side of the slidewire contact, the bridge is balanced and eb equals zero. In symbols this relation may be expressed as

$$\frac{E2}{E1} = \frac{B+S\,\Theta}{A+S\,(1-\Theta)}$$

where Θ is the position of the slidewire contact expressed as a function of the total travel (Θ varies from 0 to 1).

When the proper values of S, A, and B are chosen, and the bridge is balanced, the position Θ of the slidewire contact coincides with the movable core position.

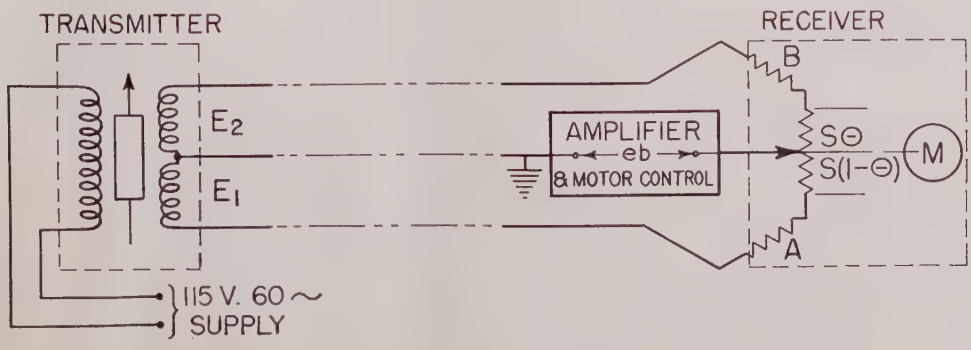


FIGURE 1 — Diagram of Bailey Electronic Telemeter Circuit

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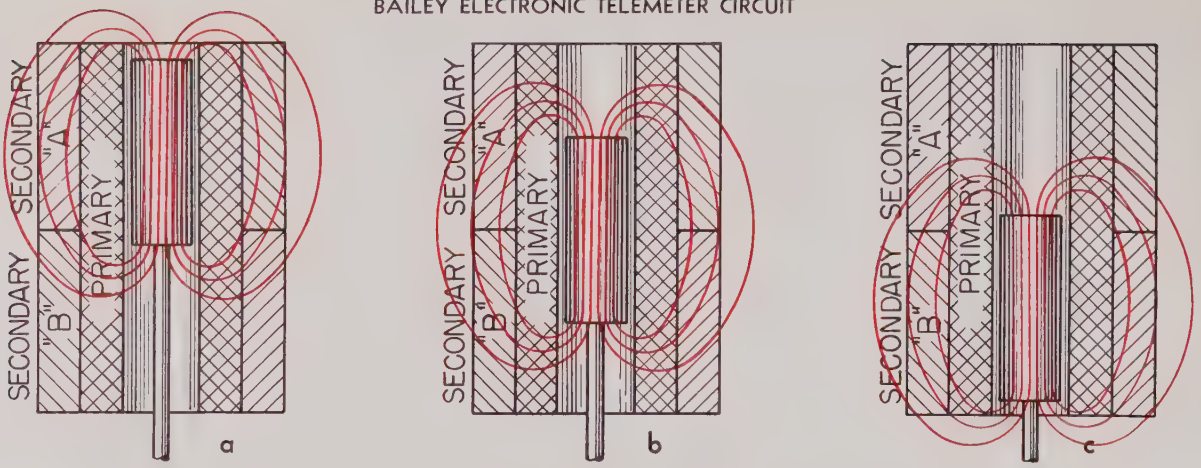


FIGURE 2 — (a) Core above center. Flux linking secondary A is greater than flux linking secondary B, and E2 is greater than E1. (b) Core at center. Equal flux linkage and E2—E1. (c) Core below center. Flux linking secondary B is greater than flux linking secondary A and E1 is greater than E2.

OPERATION OF TELEMETER BRIDGE

The purpose of this section is to explain how the Telemeter Bridge is automatically balanced so that the voltage drop eb becomes zero and the slidewire position Θ becomes a measure of the position of movable core C.

Since the Bailey Electronic Telemeter is an alternating current instrument, instantaneous polarities reverse each half cycle as will be noted by referring to the first half and second half cycle diagrams of Figure 3. In this figure the blue polarity signs show the unbalanced caused by an upward movement of transformer core C. Red polarity signs show the unbalance caused by downward movement of transformer C. Arrows indicate the direction of current flow. Plus and minus signs indicate the instantaneous polarities prevailing throughout the system.

ACTION FOR UPWARD MOVEMENT

Let us assume that the telemeter bridge is balanced so that the induced voltage E2 is equal to the voltage drop across resistance B+S Θ. As the transformer core C moves upward voltage E2 increases so that it becomes larger than the voltage drop across resistance B+S Θ. Under these conditions a voltage drop eb occurs across the telemeter bridge from the slidewire brush to connection 4 at the transmitter as indicated by the blue polarity signs. This voltage drop eb which is from right to left during the first half cycle is the telemeter bridge output. It is applied to the voltage amplifier where it is amplified approximately 2500 times. The amplified voltage ueb is applied to the grids of both triodes, A and B of the motor control tube.

In the motor control circuit it will be noted that during the first half cycle, the blue signs indicate favorable conditions for the passage of current through triode A. That is, positive *grid* voltage with respect to the cathode and positive *plate* voltage with respect to the cathode. This permits current to flow through the upper half of the motor control circuit energizing reactor A.

At the same time it will be noted that conditions are unfavorable for the passage of current through triode B since its plate is negative with respect to its cathode. During the second half cycle (see lower diagram) neither triode A or triode B conduct current when transformer core C is moving upward (blue).

Since reactor A is energized during the first half cycle, it permits the flow of current to the slidewire drive motor M, causing counterclockwise rotation. This moves the slidewire contact to balance the bridge and reduce the bridge output voltage eb to zero.

ACTION FOR BALANCED CONDITION

When voltages eb and ueb reach zero the grids of triodes A and B are at the same potential as are their cathodes and consequently no longer control the flow of plate current through triodes A and B. Without grid control both triodes pass some plate current so that reactors A and B are partially energized. This stalls the slidewire drive motor so that it does not rotate in either direction.

ACTION FOR DOWNWARD CORE MOTION

The unbalance caused by a downward motion of the transformer core C is indicated by the red arrows and red polarity signs. In this case the induced voltage E1 at the transmitter is greater than the voltage drop across resistance S (1—Θ)+A at the receiver. Under these conditions, voltage drop eb

occurs from left to right during the first half cycle as indicated by the red polarity signs.

It should be noted that the instantaneous polarity of the telemeter bridge output voltage eb is determined by the direction of transformer core motion.

Under conditions of downward motion as shown in red, triode A never passes current but triode B passes current during the second half of the a-c cycle. This energizes reactor B and drives the slide-wire motor in a clockwise direction.

A complete description of the motor control circuit and the amplifier is given in instruction section E80 "Bailey Electronic Amplifier Unit."

The actual wiring diagram used by the Bailey Electronic Telemeter Type WS35 is shown in Figure 4.

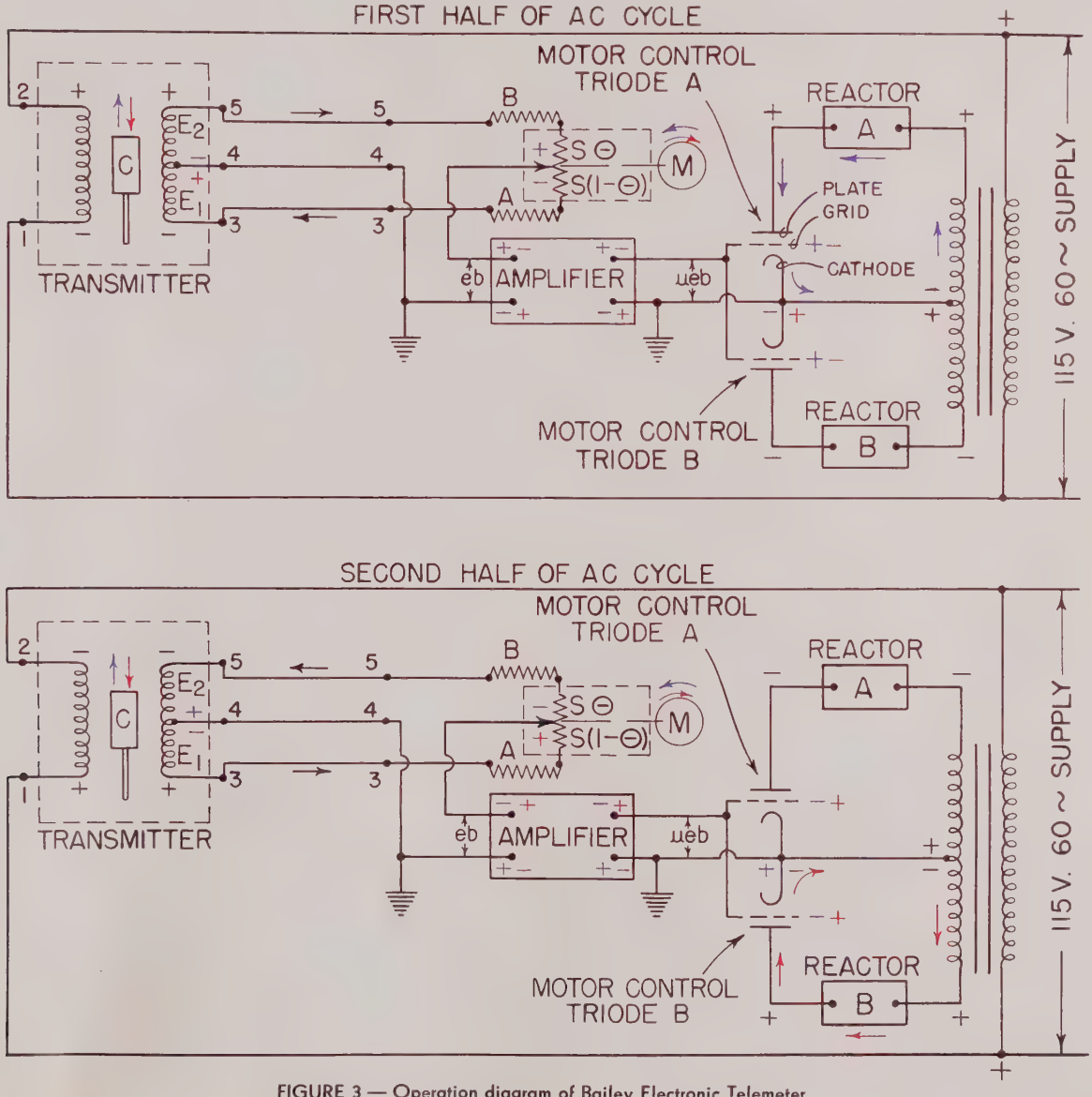


FIGURE 3 — Operation diagram of Bailey Electronic Telemeter.

BLUE shows unbalance caused by UPWARD movement of Core C.
RED shows unbalance caused by DOWNWARD movement of Core C.
Arrows indicate direction of current flow. *These diagrams are based on the accepted theory of current flow (positive to negative) although electrons are known to flow from negative to positive.*
Plus (+) signs and Minus (−) signs indicate instantaneous polarity.

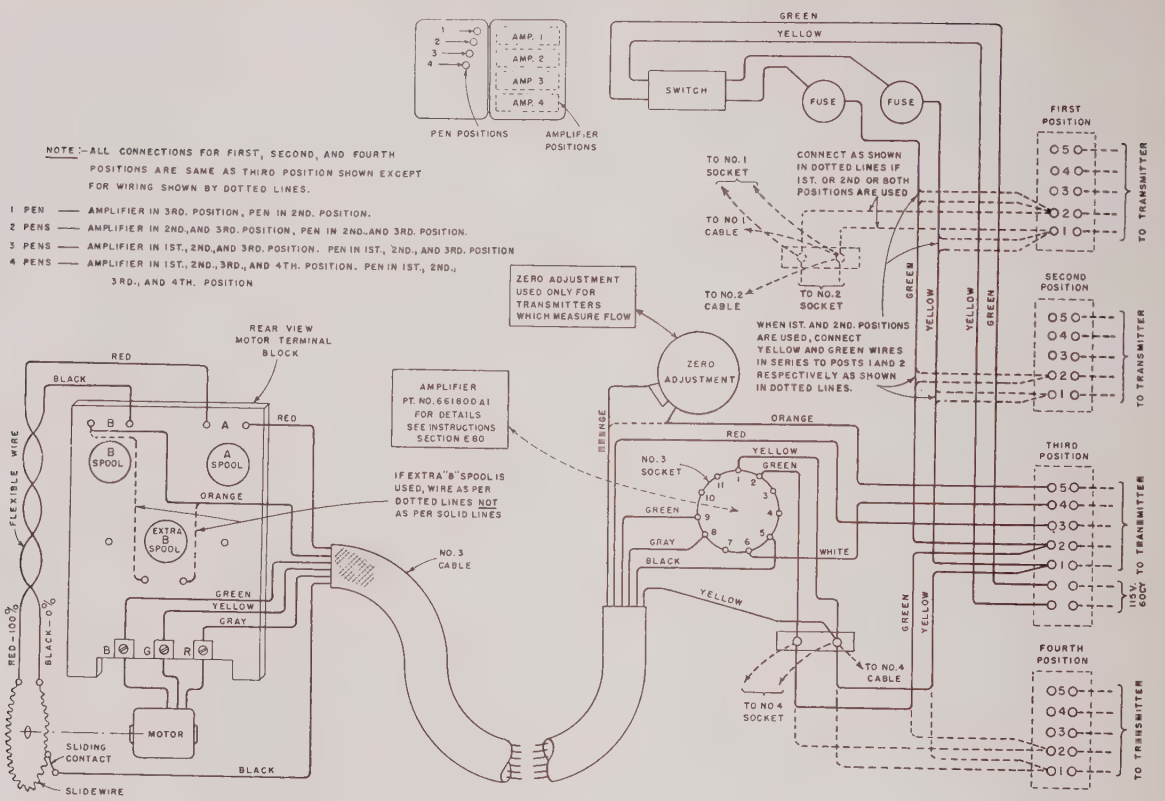

PEN POSITIONS
AMPLIFIER POSITIONS
AMP. 1
AMP. 2
AMP. 3
AMP. 4
NOTE:- ALL CONNECTIONS FOR FIRST, SECOND, AND FOURTH POSITIONS ARE SAME AS THIRD POSITION SHOWN EXCEPT FOR WIRING SHOWN BY DOTTED LINES.
1 PEN — AMPLIFIER IN 3RD. POSITION, PEN IN 2ND. POSITION.
2 PENS — AMPLIFIER IN 2ND. AND 3RD. POSITION, PEN IN 2ND. AND 3RD. POSITION.
3 PENS — AMPLIFIER IN 1ST., 2ND. AND 3RD. POSITION. PEN IN 1ST., 2ND., AND 3RD. POSITION
4 PENS — AMPLIFIER IN 1ST., 2ND., 3RD., AND 4TH. POSITION. PEN IN 1ST., 2ND., 3RD., AND 4TH. POSITION
GREEN
YELLOW
SWITCH
FUSE
FUSE
FIRST POSITION
SECOND POSITION
THIRD POSITION
FOURTH POSITION
TO TRANSMITTER
TO NO. 1 SOCKET
TO NO 1 CABLE
TO NO.2 CABLE
TO NO.2 SOCKET
CONNECT AS SHOWN IN DOTTED LINES IF 1ST. OR 2ND OR BOTH POSITIONS ARE USED
WHEN 1ST. AND 2ND. POSITIONS ARE USED, CONNECT YELLOW AND GREEN WIRES IN SERIES TO POSTS 1 AND 2 RESPECTIVELY AS SHOWN IN DOTTED LINES.
ZERO ADJUSTMENT USED ONLY FOR TRANSMITTERS WHICH MEASURE FLOW
ZERO ADJUSTMENT
REAR VIEW MOTOR TERMINAL BLOCK
AMPLIFIER PT. NO. 661800 A1 FOR DETAILS SEE INSTRUCTIONS SECTION E 80
IF EXTRA "B" SPOOL IS USED, WIRE AS PER DOTTED LINES NOT AS PER SOLID LINES
NO. 3 CABLE
NO. 3 SOCKET
B SPOOL
A SPOOL
EXTRA B SPOOL
FLEXIBLE WIRE
RED - 100%
BLACK - 0%
SLIDING CONTACT
SLIDEWIRE
MOTOR
TO NO.4 CABLE
TO NO 4 SOCKET
115V. 60CY TO TRANSMITTER

FIGURE 4 — Wiring Diagram for Bailey Electronic Telemeter.

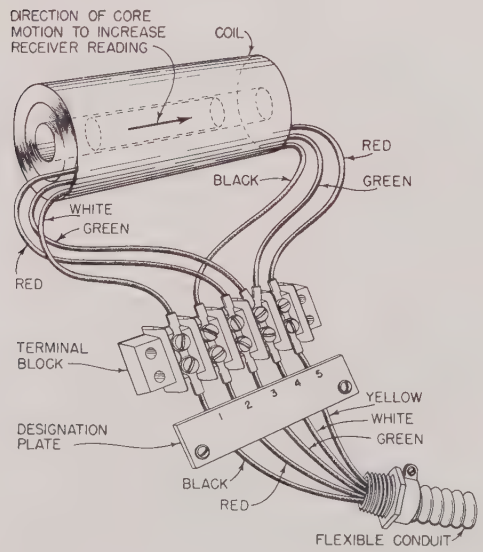


FIGURE 5 — Connection Diagram for Telemeter Transformer.

TRANSMITTER

Electrically the Bailey Electronic Transmitter consists of a transformer with one primary and two secondary windings wound concentrically on the same coil form as shown in Figure 2. This coil is usually placed over a non-magnetic tube and mounted so that its longitudinal axis is vertical. The core, made of magnetic stainless steel, is driven by a rod or small tube made of a non-magnetic material. This rod or tube is mechanically connected to the measuring device.

The transformer primary winding has a resistance of 380 ohms and is supplied with 60 cycle current at 115 volts. Each secondary winding has a resistance of 110 ohms and develops a potential of 22 volts when the movable core is centered as shown in Figure 2b. These values may vary slightly with line voltage and ambient temperature but these variations have no affect on accuracy.

TRANSFORMER CONNECTION

Leads to the transformer coil are color coded for identification. If a coil must be removed, care should be taken to reconnect these leads to the terminal block in exactly the same way as the original connections. These connections are shown in Figure 5.

CORE STROKE AND SETTING

The Bailey Electronic Telemeter will operate on movable core strokes of from .10 inches to .80 inches inclusive. In general, the actuating mechanism is designed to impart a total motion of from .20 inches to .75 inches to the core.

Ordinarily the core is set during calibration so that when the measured quantity is at zero, the center of

the core coincides with the center of the transformer coil. At this point both secondary voltages are equal and maximum stability and sensitivity are obtained.

SENSITIVITY

The telemetering system will respond to a movable core motion of less than .0001 inches. This insures better than .1% full scale sensitivity for systems having a minimum core stroke of .10 inches.

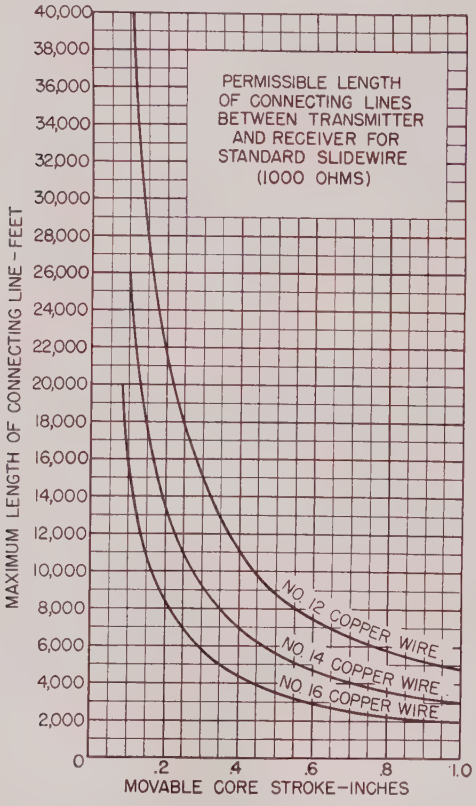


FIGURE 6 — Connecting Line Specification Curves.

ACCURACY AND STABILITY

Normal variations in line voltage and line frequency have no effect on the balance of the system and consequently on the accuracy. To maintain sensitivity and to prevent excessive heating of the transformer coil, the permissible variation in line voltage is from 105 to 125 volts.

The balance point may be affected by poor transmission line characteristics such as excessive leakage between conductors and high resistance. The resistance between lines should not be less than 200,000 ohms as measured by an insulation tester. The maximum length of line is limited only by resistance which may run as high as 20 ohms per line without producing excessive errors in calibration. The curve Figure 6 shows the relation between length of line and movable core stroke which will limit the greatest error produced by line resistance to ¼%. Longer lines may be used if the line resistance is compensated in the receiver.

The calibrated accuracy of this telemeter system alone is better than plus or minus ¼% of full scale reading.

Changes in calibration caused by aging of the transformer coils, the bridge resistors and by variations in magnetic properties of the movable core are negligible.

CONNECTING WIRES

It is recommended that the connecting wires between the transmitter and the receiver be run in conduit or shielded cable. No power wires other than those supplying the transmitter primary should be run in the same conduit.

A short length of flexible conduit should be run from the transmitter coil housing to a junction box as illustrated in Figure 7. This permits disassembly

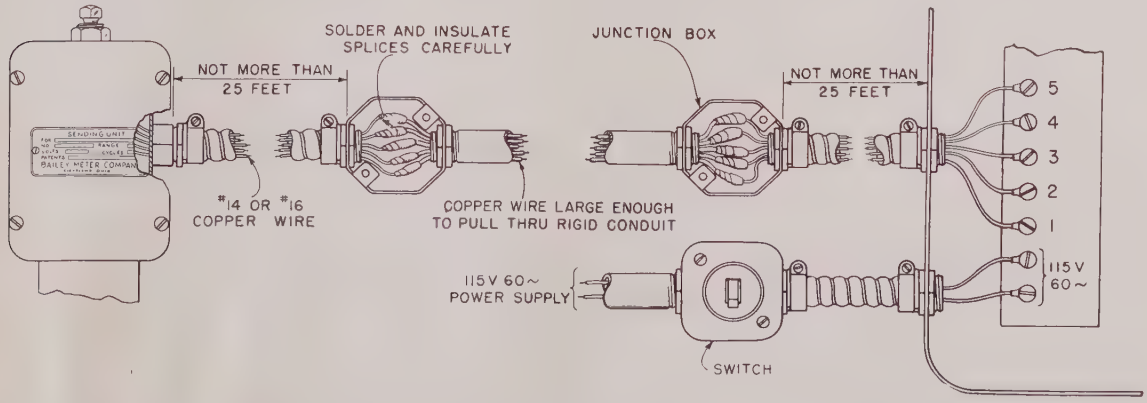


FIGURE 7 — Suggested Method of Installing Telemeter Connecting Wires. Only 3 wires need be run between the receiver and the transmitter if 115 volt power from the same source and phase is available at the transmitter. Connections 1 and 2 on the transmitter terminal block may be supplied directly from this source rather than from the receiver. Care must be taken to connect so that the instantaneous polarities of terminals 1 and 2 in both the receiver and the transmitter correspond.

of the transmitter without disconnecting wiring or conduit connections.

Figure 7 shows an approved wiring layout which may be followed when installing a Bailey Electronic Telemeter. The light weight wire at each end facilitates connections to terminals while wire in the rigid conduit must be heavy enough to withstand "pulling." Solid or stranded copper wire having rubber insulation or the equivalent is satisfactory.

POWER REQUIREMENTS

The power input to each complete telemeter unit (Transformer, Amplifier and Slidewire Drive Motor) is 60 volt-amperes at .75 power factor. This power supply must be alternating current at 115 volts and 60 cycles. Allowable voltage variation is from 105 to 125.

TRANSFORMER COIL MAINTENANCE

The transformer coil is constructed to withstand ambient temperature as high as 150° F. during operation. It is insulated to resist moisture and mildly corrosive atmospheres. Extreme conditions such as high temperatures, continuous water splashing or very corrosive fumes may result in eventual breakdown of the insulation and should be avoided.

If the coil has been immersed in water or splashed for any length of time, it should be removed from the system and dried in an oven at not more than 250° F. for several hours.

Prolonged soaking will result in excessive electrical leakage between windings and from windings to ground. To test for leakage, disconnect the transformer coil from the system and test the insulation resistance between the primary and secondary windings and between the windings and ground. Insulation resistance less than one megohm (1,000,000 ohms) indicates excessive leakage which may result in metering errors.

OPERATIONAL CHECKS AND FAULT CORRECTIONS

Failure to Operate When Installed

If the system fails to operate or operates incorrectly when first installed, it is likely that the trouble is caused by faulty installation. The following sequence of checks may be followed:

1. Make sure that both transmitter and receiver are energized when the power switch is turned on at the receiver. If the tube filaments glow, the receiver has power. If the meter is recording or integrating, operation of the chart drive motor is also an obvious indication. The transmitter may be checked by inserting an unmagnetized steel rod or screw driver into the transformer center until it strikes the core. If magnetic attraction is felt, the transmitter is energized.

A voltmeter or test lamp, if available, connected across terminals 1 and 2 at the transmitter and at the receiver will indicate connections to the power system.

2. Check connecting lines between transmitter and receiver for continuity and to make sure that they are not crossed. This can be done with a battery-bell tester or an ohm meter. If the power supply to the transmitter is not obtained from the receiver as shown by Figure 4, it is essential that the source and phase of the power supply to each unit be the same. If terminals 1 and 2 of the transmitter are reversed relative to the receiver, the slidewire drive motor will not balance the bridge but will drive the slidewire to either stop. Crossing of connections 3, 4 and 5 will make the system inoperative or may produce a false balance of the bridge.

3. If a high resistance a-c voltmeter of the type used by radio servicemen is available, check the measuring bridge voltages. If the wiring is correct, the voltages between terminals at the receiver should correspond to voltages between the same numbered terminals at the transmitter. The following table shows the approximate voltages between terminals for a .4-inch stroke transmitter.

Coil Connection (See Fig. 5)	*Movable Core at Zero Position*	*Movable Core at Maximum Position*
1-2	115	115
3-4	22	16
4-5	22	28
3-5	44	44

4. If the amplifier and motor control circuit are operating correctly, the motor will drive the slidewire to balance rapidly, and will respond to the slightest motion of the movable core in the transmitter. At balance the voltage from the slidewire contact to the receiver casing or ground should be zero. If the slidewire is turned by hand in either direction, this voltage should rise smoothly and continuously. If the voltage change is erratic or if the positioning motor tends to oscillate, check the slidewire contact and wipe the slidewire with a clean dry cloth.

If inspection and the above checks fail to reveal the source of trouble or if the telemeter operation becomes faulty after being in service, the following charts should be helpful in locating and eliminating the trouble.

FAULT CORRECTION CHART FOR BAILEY ELECTRONIC TELEMETER

Fault	*Probable Causes*	*Check*	*Remedy*
I — Pen draws circles on the chart and does not respond to changes of measured quantity.	(*a*) Transmitter core does not respond to changes of measured quantity. Core may be locked or frozen in tube or actuating mechanism may be faulty. (*b*) Tube failure. (*c*) Amplifier failure. (*d*) Amplifier input short circuited in recorder wiring. (*e*) Motor rotor frozen in bearings or gear unit jammed.	(*a*) Move the transmitter core by hand and observe receiver operation. If response is rapid and sensitive, the electrical system is OK and the trouble is mechanical. (*b*) Test tubes or observe operation with replaced tubes. (*c*) Observe operation with good amplifier. (See Section E80 for detailed instructions on amplifier.) (*d*) Check resistance between contact No. 5 on amplifier socket and ground. This should exceed 200,000 ohms. (*e*) Turn off electric power. Disconnect center motor lead from meter circuit and attempt to run motor connected directly to 115 volt supply. (See Section E85 for detailed instructions on slidewire unit.)	(*a*) Repair transmitting mechanism. Dismantle and clean if necessary. (*b*) Replace defective tubes. (*c*) If trouble is not known or cannot be repaired, replace amplifier and return defective unit to factory (see Instruction Section E80). (*d*) Repair defective wiring if possible. (*e*) Disassemble motor, clean and oil. (See Section E85 for detailed instructions on slidewire unit).
II — Erratic pen or indicator pointer motion (unless caused by rapidly changing variable).	(*a*) Faulty slidewire contact. (*b*) Loose connection in the measuring circuit. (*c*) Loose connection in recorder or amplifier. (*d*) Defective tube caused by interelectrode short. (*e*) Flexible leads to slidewire grounded or shorted due to wearing of insulation.	(*a*) Press contact against slidewire and observe operation. (*b*) Test external circuit with ohmmeter or voltmeter. (*c*) Eliminate (*a*) and (*b*) causes by test. Inspect connections in recorder and amplifier. (*d*) Test tubes or replace with good tubes and observe operation. (*e*) Remove slidewire assembly and inspect leads.	(*a*) Increase contact pressure. Clean slidewire. (*b*) Tighten terminal screws. Replace broken wiring. (*c*) Repair if possible. If the fault is in the amplifier and cannot be found, replace and return defective unit. Examine flexible lead to slidewire. (*d*) Replace defective tube. (*e*) Replace defective leads.
III — Pen drifts over chart or to either end without following variable.	(*a*) Transmitter primary or connections to transmitter open. (*b*) Amplifier tube failure. (*c*) Defective amplifier.	(*a*) Test coil and wiring with an ohmmeter. Also secondary voltages measured at terminals 3, 4 and 5 indicate circuit continuity. (*b*) Test tubes. (*c*) Try operation with new amplifier. (See Section E80 for detailed amplifier instructions.)	(*a*) Replace defective coil or repair wiring. (*b*) Replace defective tubes. (*c*) Repair or replace defective amplifier.
IV — Pen or pointer oscillates at one point without changing position with change in measured variable.	(*a*) Open slidewire at point of oscillation.	(*a*) Check slidewire by visual inspection or with an ohmmeter. Open connections 3 or 5 to the transmitter to eliminate parallel circuits.	(*a*) Replace slidewire (See Section E85 for detailed instructions on slidewire unit).
V — Pen or pointer travels at full speed to top of chart or scale and does not follow variable.	(*a*) Open secondary No. 1 connected to terminals 3 and 4. (*b*) Open resistor "A." (*c*) Open line 3 to 3. (*d*) Grounded line 3 to 3. (*e*) Broken flexible lead to 100 per cent end of slidewire.	(*a*) Check transformer coil with ohmmeter or voltmeter. (*b*) Check resistor "A" with connection No. 3 open. (*c*) Check external wiring. (*d*) Check external wiring (*e*) Check circuit with ohmmeter.	(*a*) Replace coil. (*b*) Replace resistor. (*c*) Repair wiring. (*d*) Repair wiring. (*e*) Replace defective wire.
VI — Pen or pointer travels at full speed to bottom of chart or scale and does not follow variable.	(*a*) Open secondary No. 2 connected to terminals 4 and 5. (*b*) Open resistor "B" or zero adjustment potentiometer. (*c*) Open line 5 to 5. (*d*) Grounded line 5 to 5. (*e*) Broken flexible lead to zero end of slidewire.	(*a*) Check transmitter coil with ohmmeter or voltmeter. (*b*) Check resistor "B" and potentiometer with connection No. 5 open. (*c*) Check external wiring. (*d*) Check external wiring. (*e*) Check slidewire unit circuit.	(*a*) Replace coil. (*b*) Replace resistor. (*c*) Repair wiring. (*d*) Repair wiring. (*e*) Replace defective wire.

CONTINUED ON NEXT PAGE

FAULT CORRECTION CHART FOR BAILEY ELECTRONIC TELEMETER — Continued

Fault	*Probable Causes*	*Check*	*Remedy*
VII — Insensitive or sluggish operation.	(*a*) Defective amplifier or tubes. (*b*) Excessive leakage between power and measuring circuits.	(*a*) Try operation with new tubes. Try operation with new amplifier. (*b*) Voltmeter between slidewire contact and ground indicates voltage at balance. Ohmmeter shows less than 500,000 ohms resistance between bridge circuit and power circuit of meter with grounded line No. 4 in bridge disconnected from recorder.	(*a*) Replace defective tubes or amplifier or both (see Section E80 for detailed instructions on amplifier). (*b*) If excessive leakage is caused by splashing or dropping water, dry out meter. Move meter to better location if possible. Replace external lines with waterproof wire if necessary.
VIII — Meter out of calibration.	(*a*) Mechanical damage such as bent links, loosened adjustment, etc., in receiver. (*b*) Mechanical damage or shift in transmitter adjustment such as change in coil position relative to core; excessive friction between core and tube due to bent parts, etc. (*c*) Excessive electrical leakage between lines or from measuring circuit to ground or between transmitter windings. (*d*) Change in resistors A or B and in slidewire caused by shortened turns, grounds, etc. (*e*) Shorted turns in transmitter windings.	(*a*) Inspect meter and check end points and pen travel. (*b*) Inspect transmitter and check operation of movable core. (*c*) See VII (*b*) above. (*d*) Test for proper resistance values with an ohmmeter. (*e*) Check winding resistance and voltages with test meter.	(*a*) Readjust if necessary. Repair or replace damaged parts. (*b*) Readjust zero position of movable core. Repair or replace damaged parts. (*c*) See VII (b) above. Also dry transmitter coil at 220-250° F. if trouble is caused by wet coil. (*d*) Replace defective components. (*e*) Replace defective coil.

FOR THE INSTALLATION, ADJUSTMENT AND MAINTENANCE OF

BAILEY ELECTRONIC TELEMETER

DIFFERENTIAL PRESSURE TRANSMITTER (BELLOWS-OPERATED TYPE CS1)

GENERAL DESCRIPTION

The bellows type differential pressure transmitter used with Bailey Telemeters is illustrated in Figure 1. The unit consists of a pressure housing which contains a stainless steel or bronze bellows and a calibrated balancing spring attached to the free end of the bellows. Pressure connections in the housing are arranged so that the higher pressure is impressed on the outside of the bellows. The differential between this pressure and the lower inside pressure compresses the bellows and increases the tension on the calibrated spring.

Normally, the desired range of pressure differential is obtained by selecting the proper calibrated spring and any substantial change in operating differential is secured by changing the calibrated spring.

Maximum and minimum limit stops are provided at the free end of the bellows so that the units will stand considerable excess differential pressure or reverse differential pressure without damage. The maximum limit stop is adjustable so that the stroke of the bellows can be varied.

Motion of the free end of the bellows is transmitted through a solid link to an iron core which moves inside a stainless steel tube around which is installed the transformer coil. The standard coil consists of a single primary and two secondary windings, all on the same coil form. Motion of the iron core transmitted from the free end of the bellows varies the ratio of the voltages across the two output windings of the transformer secondary. This variable voltage ratio is used to operate the telemeter receiver as described in another section of the instructions.

SERVICE

The pressure housing is of forged steel construction and suitable for pressures up to 1500 lb. per square inch. Bellows and spring combinations are available for differential pressure ranges from 20 to 400 inches of water. The units may be used on most gases and with all liquids which are not excessively corrosive and which will not congeal within the pressure housing. Where there is a likelihood of freezing of liquid in the pressure housing, heaters may be applied to keep the housing at a steady temperature above the freezing point of the liquid.

When used to measure condensable vapors, it is advisable to provide radiator-reservoirs in the connecting lines near the vapor line. This provides condensate to fill the pressure chamber and connecting piping up to a fixed level in the radiator-reservoirs. It is essential that these radiator-reservoirs be at the same level to equalize the columns of liquid in the two pressure connections.

INSTALLATION

The transmitter is always mounted in a vertical position as shown in Figure 2. For measurement of steam, condensable gases and liquids the coil ex-

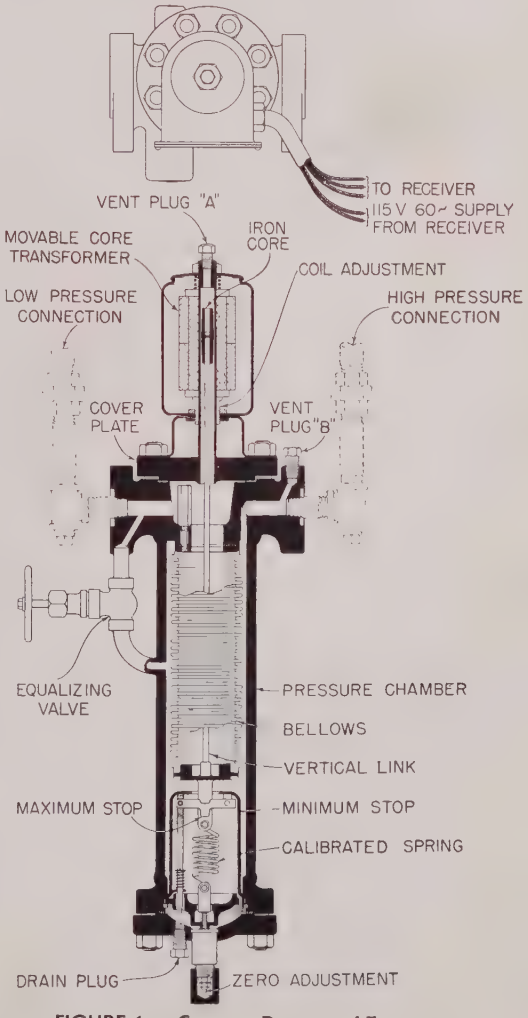


FIGURE 1 — Cutaway Drawing of Transmitter.

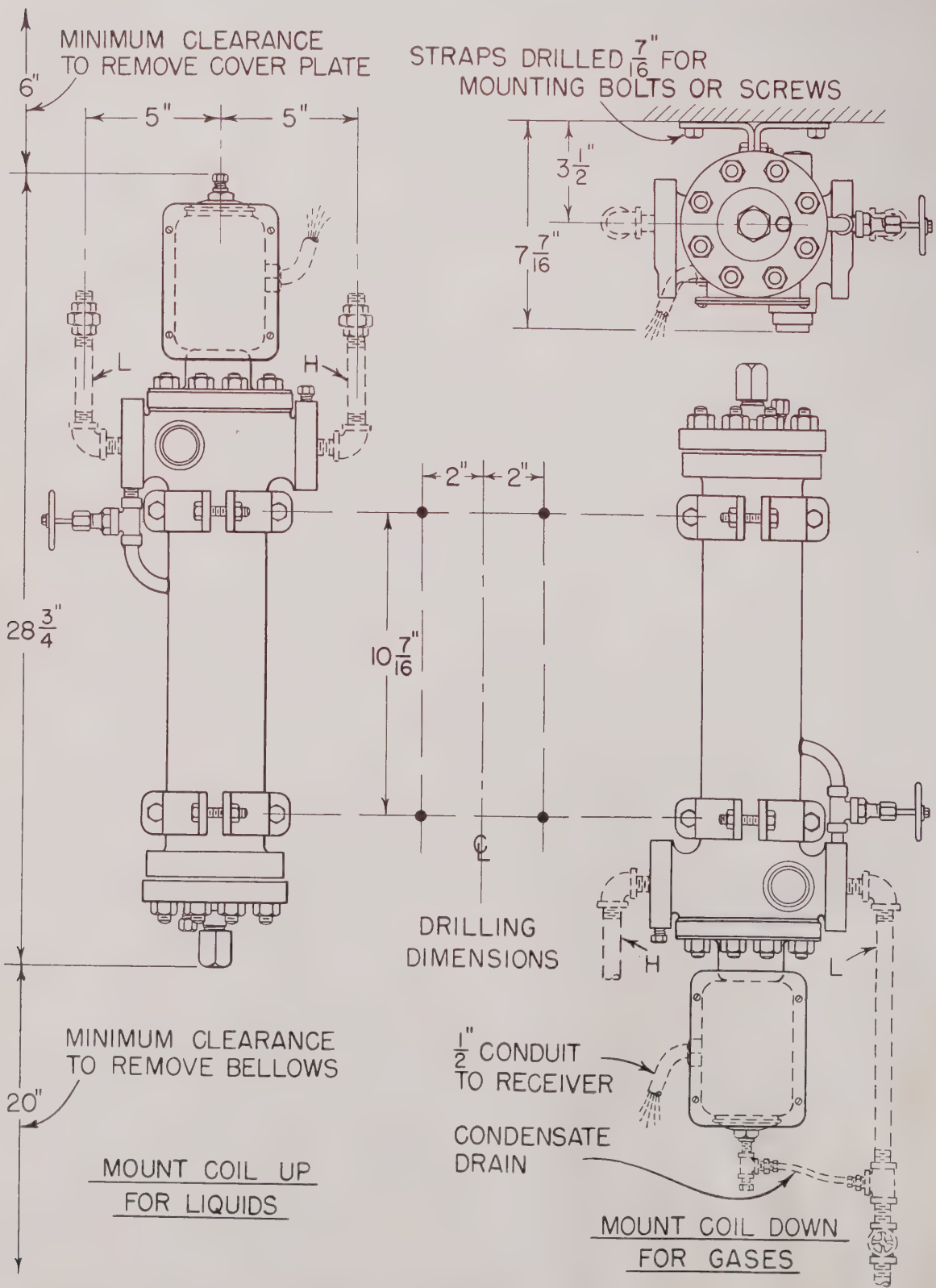


FIGURE 2 — Mounting drawing for Transmitters.

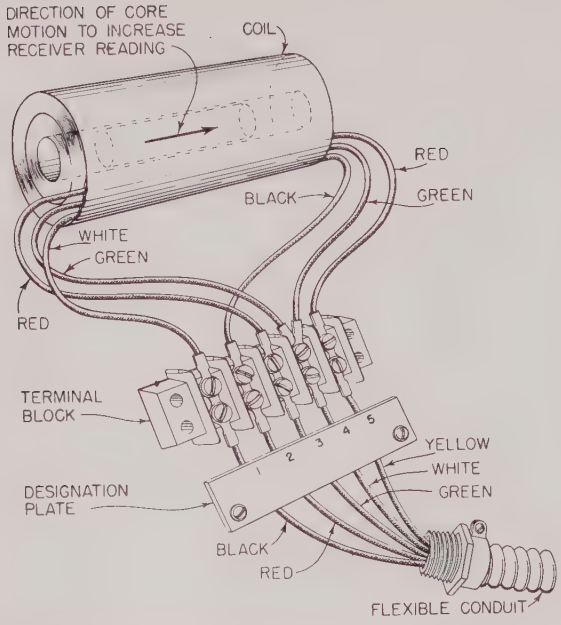


FIGURE 3 — Transformer Connection Diagram.

tends upward; for measurement of non-condensable gases the entire transmitter is inverted so that the coil extends downward. Figure 2 also shows the location of drilled holes for the mounting straps and the method of mounting the transmitter with these straps.

Locate the transmitter as close as possible to the point of measurement to keep the connecting piping short. Clearance both above and below the pressure chamber must be allowed as indicated in Figure 2. Piping should be run so that lines have a slope of at least one inch per foot, and should be properly supported throughout the entire length, in order to avoid air traps and water pockets. When the transmitter is located close to the pressure source, only one valve is required in each connecting line, this valve being located close to the source of pressure. In case the transmitter is located some distance from the pressure source for special reasons, it may be advisable to have two valves in each connecting line, one at the pressure source and one at the meter connection.

For complete instructions regarding installation of connecting piping, see Bailey Meter Instruction M 20-A.

WIRING

A short length of ½-inch flexible conduit with five color coded wires is attached to the terminal box at the top of the transmitter. This flexible conduit should be run to a junction box located so that the pressure chamber cover plate may be removed without disconnecting wiring. Connections inside the transmitter terminal box are marked in accordance with the transformer connection diagram, Figure 3. If the transmitter is installed so that the terminal box cover faces the wall, the cover plate flange may be opened, rotated and replaced at any angle which provides easy access to the terminal box. In the average application the connecting wires between the transmitter and receiver should be sized to maintain the resistance per conductor at less than 20 ohms.

ASSEMBLY

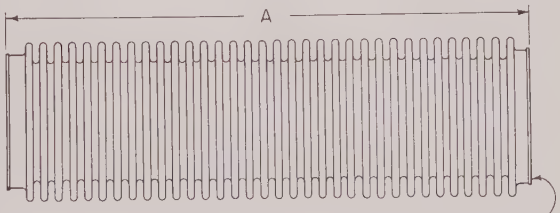
Normally, the transmitter is shipped with all internal parts properly assembled so that it is ready for operation when the pressure connections are made.

When disassembling the transmitter, first make sure that there is no pressure in the connecting piping and open the equalizing valve as shown in Figure 1. Next remove the cover plate by breaking the flanged joint. After the cover plate has been removed, siphon any condensate from the inside of the bellows and then drain the housing by removing the drain plug in the bottom flange. The lower flanged joint can then be broken and the bottom flange removed.

Remove the zero adjustment guide base assembly, part No. 34898-1, Figure 7, by loosening the locking screws and springing the retainer, part No. 34904-1, from its groove.

The bellows and spring assembly will come out as a unit after removing the nuts, part No. 34984-1 which secure the upper end of the bellows.

To reassemble, reverse the procedure. In case the bellows has been strained in handling, restore it to the proper length indicated on Figure 4 before assembly. This can be done by lightly compressing or extending the bellows to achieve the proper free length.



FREE LENGTH A	KEY NO ON BELLOWS
8 13/16"	D1
9"	A1
9"	A1Y
9"	A2Y

FIGURE 4 — Correct free length of bellows.

STARTING UP

Transmitters operating on liquids or condensate should be completely filled before pressure is applied.

When there are no valves in the connecting lines between the transmitter and radiator-reservoirs, it is advisable to fill the entire system by adding condensate at the vent hole in the low pressure reservoir assembly. When starting to fill the system, the vent plugs A and B in the transmitter, Figure 1, should be removed and sufficient condensate run through the system to vent any air present on either side of the bellows. The equalizing valve should be open throughout the filling process.

After venting the air from the housing replace the vent plugs A and B and continue to fill at the reservoir until all the connecting piping and reservoirs are filled with condensate.

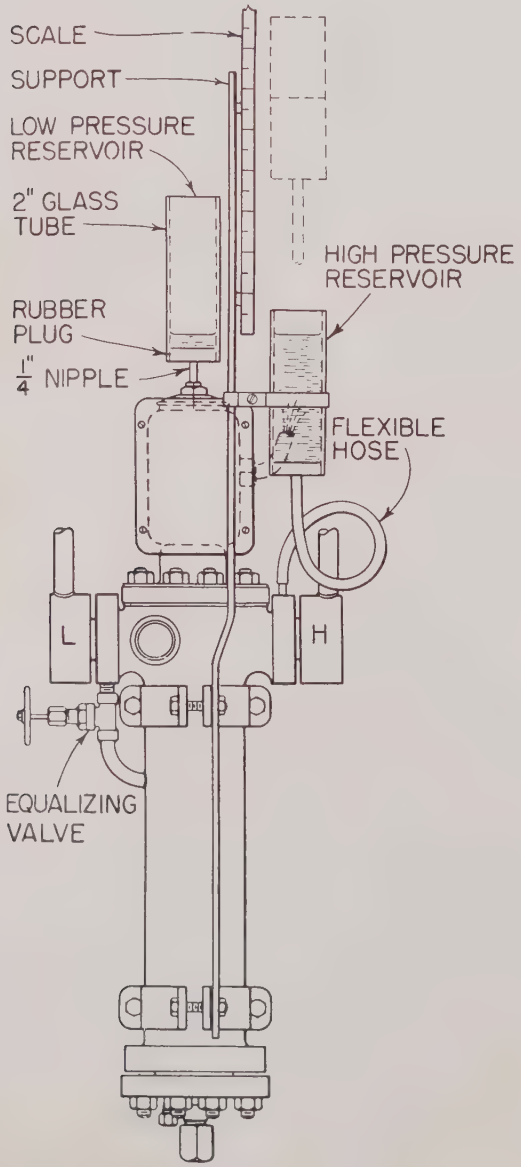


FIGURE 5 — Calibration set up for liquid filled Transmitter.

Replace the reservoir vent plugs, make sure equalizing valve is open, and apply pressure by opening the high pressure radiator-reservoir valve slowly. Examine all connections and flanged joints for leaks. If the system is tight, close the equalizing valve and open the second radiator-reservoir valve.

ADJUSTMENT

The transmitter is provided with three adjustments:

1. ***Zero Spring Adjustment:*** — This adjustment is made by a key or wrench on the adjustment screw extension, part 34927-1, Figure 7. The equalizing valve must be open and the sealing cap, part 34965-1, removed when the adjustment is made. The adjustment can be made with some pressure on the body though it is advisable not to remove the sealing cap when extremely high pressures exist in the transmitter.

2. ***Maximum Stroke Adjustment:*** — This adjustment limits the maximum travel of the bellows. It is set to stop motion of the bellows at approximately 2 per cent beyond the normal working stroke. The adjustment may be made by means of a key through the drain hole in the bottom flange.

3. ***Transformer Coil Position Adjustment:*** — This adjustment is made by turning the coil adjustment nut, part 661326-1, Figure 7. Lock nut, part 661324-1 is provided to secure the adjustment.

The only operating adjustments are the zero spring adjustment and the coil position adjustment. With the pressure chamber in proper operating condition, that is, both top and bottom flange joints properly made up, and housing filled with condensate if normal operation requires it, the zero spring adjustment is set so that the free end of the bellows is within $\frac{1}{32}$-inch of the zero stop. To make this setting open the equalizing valve, close valves in the connecting lines and remove the vent plug A at the top of the coil housing. Use a non-metallic push rod to force the movable core downward until the bellows hits the stop. Measure the travel from the free floating position to the stop position.

After this distance to the zero stop has been set and the receiver has been placed in service, check the zero reading of the receiver. With the electric circuit energized and the transmitter equalizing valve open the receiver reading should just float on zero. If it takes more than several turns of the zero adjustment screw to secure a floating zero at the receiver, turn the screw back and use the transformer coil position adjustment. If difficulty is experienced in securing an exact zero by positioning

the coil, final adjustment may be made by the zero adjusting screw providing the free end of the bellows stays between $\frac{1}{64}$ and $\frac{3}{64}$ inches from the zero stop.

CALIBRATION OF LIQUID FILLED TRANSMITTERS

To check the calibration of a unit operating on liquids or condensable gases, the telemeter receiver should be connected and placed in service, and a water column calibrating device prepared similar to Figure 5. This calibrating device can readily be made up out of glass tubing, rubber stoppers, pipe nipples and hose.

The procedure to be followed during calibration follows:

1. With the transmitter equalizing valve open, fill the entire system by adding water to the low pressure calibrating reservoir until all air is vented from the system and water is visible in both glass reservoirs at the same elevation.

2. Adjust the transmitter zero as outlined under "adjustments."

3. Close the transmitter equalizing valve and apply a water column head equal to full scale deflection as indicated on the meter data sheet.

4. If the receiver does not read exactly full scale reading, adjust the linkage between the slidewire drive arm and the recording pen or indicating pointer as described on the slidewire unit instruction sheet. Several trial adjustments between zero and maximum scale may be necessary to obtain the proper linkage adjustment.

5. After obtaining the proper zero and full scale calibration adjustments, the maximum stop cam on the slidewire disc should be set to permit about $\frac{1}{8}$-inch travel of the slidewire beyond the full scale reading. See slidewire unit instructions when making this maximum stop adjustment.

6. Normally after the above adjustments are made, the meter will calibrate throughout the range of travel. If the zero and maximum scale adjustments are correct and intermediate positions do not check, correction can be made by altering the angularity of the driving linkage or by reshaping the driving cam on the slidewire unit. Do not alter angularity of linkage or cam shape without carefully checking all other adjustments since these were properly set during factory calibration and should not require change.

CALIBRATION OF GAS-FILLED TRANSMITTERS

To check the calibration of a unit operating on gas or air the low pressure connection is opened to atmosphere and a water or mercury U-tube is connected in parallel with the high pressure connection as shown in Figure 6. Air or gas pressure equal to the desired deflection as shown on the meter data sheet is applied to the high pressure side and measured by the U-tube.

With the exception of the method of applying differential pressure to the transmitter, calibrating procedure for air or gas is the same as for liquids.

MAINTENANCE

The connecting piping must be kept tight since leaks in this piping may have considerable effect on the differential pressure transmitted to the meter. If radiator-reservoirs are used, these reservoirs must be maintained level lengthwise and with each other for continued accurate results.

Connecting piping should be blown occasionally so that it will not become plugged with dirt, scale, or sediment. If there seems to be a tendency for the piping to collect considerable dirt, settling chambers should be installed. These may be purchased from Bailey Meter Company or fabricated from pipe sections.

CAUTION

Whenever steam lines are blown down, do not open meter valves until sufficient time has elapsed

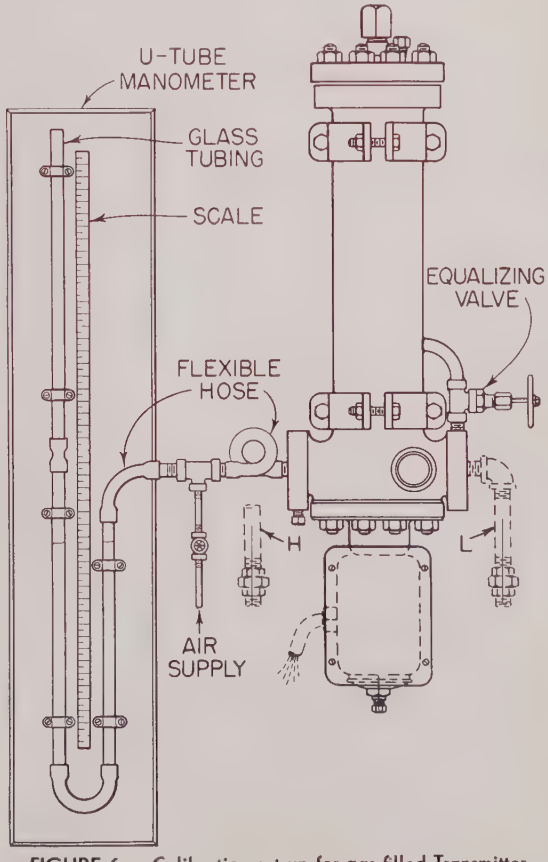
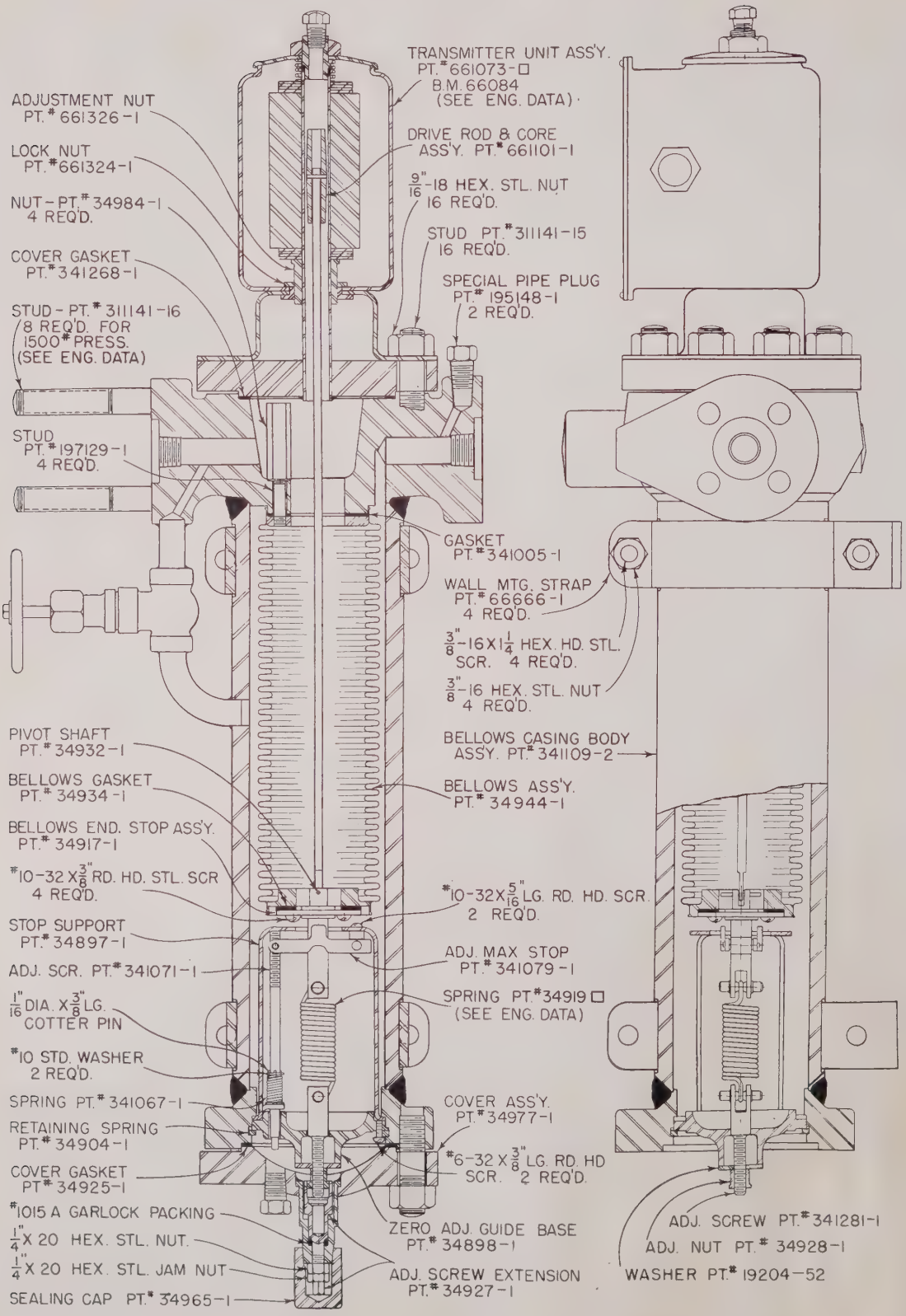


FIGURE 6 — Calibration set up for gas filled Transmitter.


TRANSMITTER UNIT ASS'Y. PT.# 661073-□ B.M. 66084 (SEE ENG. DATA)
ADJUSTMENT NUT PT.# 661326-1
LOCK NUT PT.# 661324-1
NUT - PT.# 34984-1 4 REQ'D.
COVER GASKET PT.# 341268-1
STUD - PT.# 311141-16 8 REQ'D. FOR 1500# PRESS. (SEE ENG. DATA)
STUD PT.# 197129-1 4 REQ'D.
DRIVE ROD & CORE ASS'Y. PT.# 661101-1
9/16-18 HEX. STL. NUT 16 REQ'D.
STUD PT.# 311141-15 16 REQ'D.
SPECIAL PIPE PLUG PT.# 195148-1 2 REQ'D.
GASKET PT.# 341005-1
WALL MTG. STRAP PT.# 66666-1 4 REQ'D.
3/8-16X1 1/4 HEX. HD. STL. SCR. 4 REQ'D.
3/8-16 HEX. STL. NUT 4 REQ'D.
BELLOWS CASING BODY ASS'Y. PT.# 341109-2
BELLOWS ASS'Y. PT.# 34944-1
PIVOT SHAFT PT.# 34932-1
BELLOWS GASKET PT.# 34934-1
BELLOWS END. STOP ASS'Y. PT.# 34917-1
#10-32 X 3/8" RD. HD. STL. SCR 4 REQ'D.
#10-32 X 5/16" LG. RD. HD. SCR. 2 REQ'D.
STOP SUPPORT PT.# 34897-1
ADJ. SCR. PT.# 341071-1
ADJ. MAX STOP PT.# 341079-1
SPRING PT.# 34919 □ (SEE ENG. DATA)
1/16" DIA. X 3/8" LG. COTTER PIN
#10 STD. WASHER 2 REQ'D.
SPRING PT.# 341067-1
RETAINING SPRING PT.# 34904-1
COVER ASS'Y. PT.# 34977-1
#6-32 X 3/8" LG. RD. HD SCR. 2 REQ'D.
COVER GASKET PT.# 34925-1
#1015 A GARLOCK PACKING
1/4" X 20 HEX. STL. NUT.
1/4" X 20 HEX. STL. JAM NUT
SEALING CAP PT.# 34965-1
ZERO ADJ. GUIDE BASE PT.# 34898-1
ADJ. SCREW EXTENSION PT.# 34927-1
ADJ. SCREW PT.# 341281-1
ADJ. NUT PT.# 34928-1
WASHER PT.# 19204-52

NOTE: SPECIFY BOTH METER SERIAL NO. AND PART NO. IN ORDERING PARTS

FIGURE 7 — General Assembly and Parts Drawing.

to allow the connecting lines to fill with condensate.

If the meter appears to be sluggish, it is possible that the bellows and pressure chamber have become fouled with dirt or sludge. The bellows should be removed and the meter body and bellows cleaned with water or solvent.

Follow instructions given under "assembly" when removing the internal parts for cleaning.

MAINTENANCE — ELECTRICAL

The transformer coil is constructed to withstand ambient temperatures as high as 150° F. during operation. It is insulated to resist moisture and mildly corrosive atmosphere. However, extreme conditions such as high temperature, splashing water, or very corrosive fumes may result in eventual breakdown of the insulation and should be avoided. The flexible conduit on outdoor installations must be waterproofed by tape or other means.

If the coil has been immersed in water or splashed for any length of time, it should be removed from the system and dried in an oven at about 250° F. for several hours.

When installing the transformer coil, it is important that wires be connected in accordance with the color code shown on the wiring diagram, Figure 3. If the primary leads are incorrectly connected, the meter may operate in the wrong direction. If secondary connections are improperly connected, the meter may lose sensitivity or operate in the wrong direction.

See the general telemeter instruction sheet for more detailed information regarding the electrical circuit.

FOR THE INSTALLATION AND MAINTENANCE OF

THE BAILEY ELECTRONIC AMPLIFIER UNIT

FUNCTION

The function of the amplifier unit is to detect and amplify voltage produced by unbalance in the measuring circuits. The amplified output is applied to a motor control circuit which causes the slidewire drive motor to run in the required direction for rebalancing the measuring circuit.

MECHANICAL DESIGN

An amplifier unit for each quantity being measured is mounted on the rear of the receiver casing as shown in Figure 1. Substantial dust and moisture proof covers provide protection to the unit and easy access to vacuum tubes.

The complete unit consists of an amplifier section, a power supply section and a motor control section all of which are assembled into the compact group shown in Figure 4.

MOUNTING

The amplifier unit is normally mounted on the back of the receiver casing as shown in Figure 1. Electrical connections to the receiver are made by a plug and socket connector. When such mounting is impossible, the amplifier may be mounted as far as 50 feet from the receiver. In this case electrical connections to the amplifier are made by means of a plug and cable assembly as shown in Figure 3. Amplifiers are usually packed in a separate carton in the shipping case.

SENSITIVITY

The amplifier has an overall maximum voltage gain of 2500. This means that a .001 volt unbalance from the measuring circuit will produce an output voltage of 2.5 volts for application to the motor control circuit. Since the slidewire drive motor responds to voltages as low as one volt input to the 6N7 motor control tube, it is sensitive to about .0004 volts input to the amplifier. This sensitivity is further illustrated in terms of degrees temperature and inches of transmitter motion by the following table.

SLIDEWIRE DRIVE MOTOR SENSITIVITY

CIRCUIT	VOLTS (Bridge Output	DEGREES F (Pyrotron)	INCHES MOTION (Telemeter)
Standard	.0004	.4	.00005
Bridge Transformer	.00003	.025	

SENSITIVITY ADJUSTMENT

The rheostat-potentiometer R8 in the amplifier output circuit is used to adjust the sensitivity of the system to a maximum beyond which the balancing

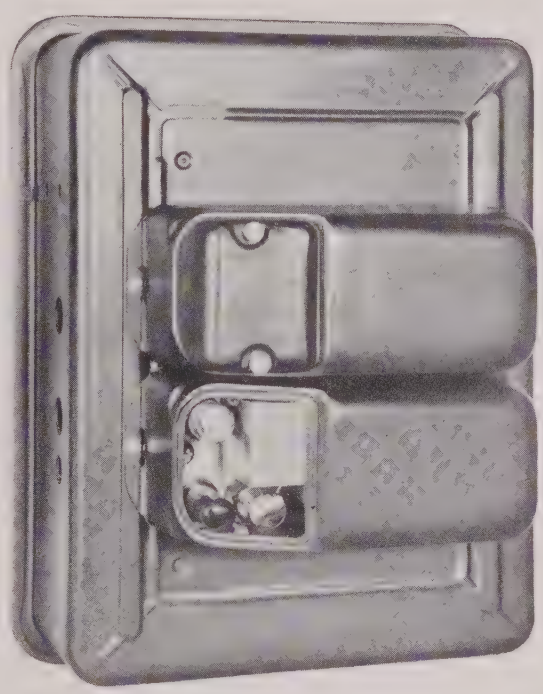


FIGURE 1 — Amplifier Units mounted on rear of Receiver Casing with tube cover removed from lower amplifier.

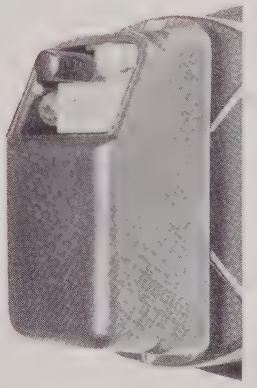


FIGURE 2 — Amplifier Unit mounted on rear of round Receiver Casing.

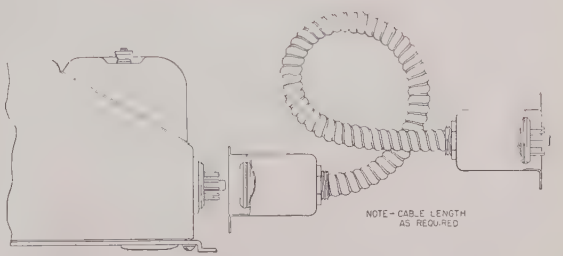


FIGURE 3 — Amplifier Unit with plug and cable for remote mounting

motor would operate continuously. The slotted shaft of this resistor projects through a small hole in the back of the receiver casing for easy adjustment. In remote mounted amplifiers the adjustment is made by removing the tube cover.

ARRANGEMENT OF COMPONENTS

As indicated on Figure 4, the amplifier unit is made up of three sub-assemblies; (1) the chassis, (2) the reactor-transformer assembly, (3) the condenser-resistor assembly.

On the chassis, Figure 6, are mounted vacuum tube and condenser-resistor assembly sockets, filter condensers, C9 and C4, resistors, R10, R9, R6, and R4, and the sensitivity adjusting resistor-potentiometer, R8.

The remainder of the resistors and condensers in the amplifier are assembled into the condenser-resistor assembly which plugs into a socket in the chassis. There are two variations in this unit; part No. 661730A1 is used on all standard range Pyrotrons, Telemeters, D-C Recorders and O_2 Recorders while part No. 661730A2 is used only on low range Pyrotrons. The difference between these units is in the C3 condenser as indicated by the complete wiring diagram Figure 11. The low range Pyrotron with a bridge output transformer requires a condenser-resistor assembly with a .006 mfd. C3 condenser in place of the standard .05 mfd. condenser.

The reactor-transformer assembly includes the power supply transformer and a metal casing which houses the motor control reactors and condensers C10, C11 and motor condenser C12. All inter connections between the reactors, transformer and condensers are made in the housing before it is filled with compound to keep moisture out of the reactor coils.

ELECTRICAL FEATURES

Electrically the power amplifier may be divided into the following three sections, each of which performs a separate function:

(1) D-C power supply.

(2) Voltage amplifier which amplifies the output voltage of the measuring circuit.

(3) Motor control circuit which receives the output voltage of the amplifier and controls direction of rotation and speed of the reversing motor.

D-C POWER SUPPLY

The D-C power supply is obtained from a simple full-wave rectifier using a 6X5 vacuum tube and a

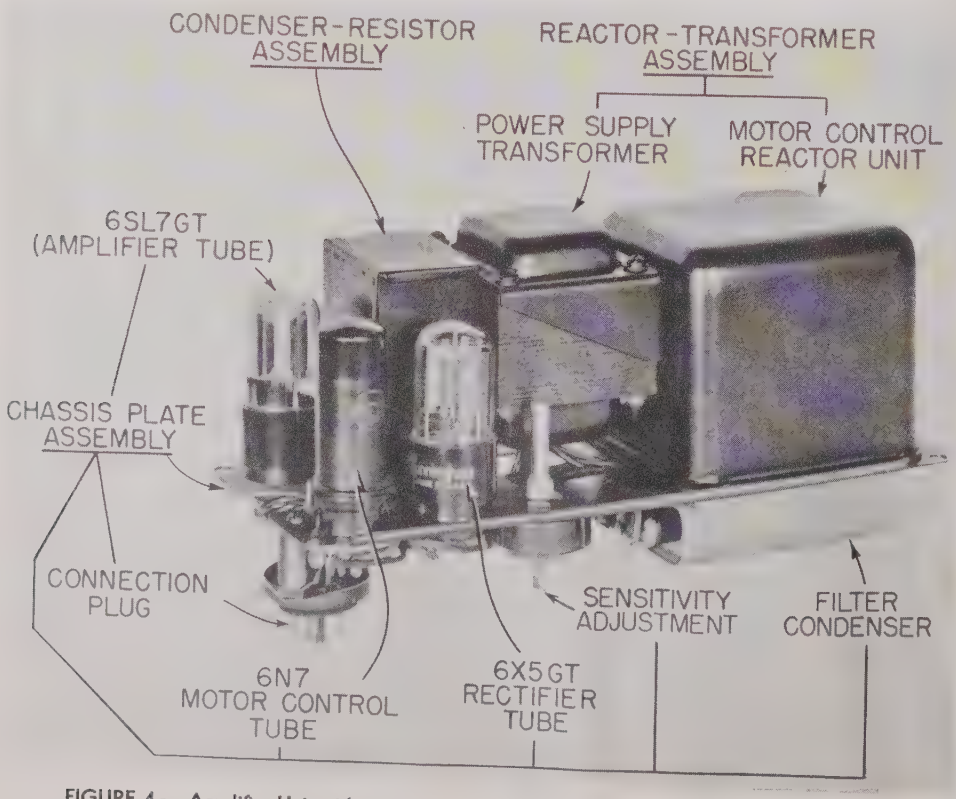


FIGURE 4 — Amplifier Unit with protecting covers removed and major assemblys indicated.

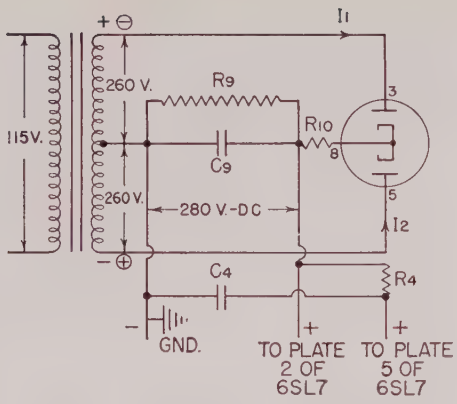


FIGURE 5 — Diagram of D-C Power Supply.

capacitor resistance filter to provide smooth d-c voltage. The wiring diagram of this power supply is shown in Figure 5.

VOLTAGE AMPLIFIER

This is a Class A amplifier of conventional design consisting of two stages of resistance coupled amplification. A 6SL7 amplifying tube consisting of two triodes in one envelope is employed. Each triode amplifies voltage applied to its grid about 50 times so that the voltage gain of the amplifier is about 2500. An elementary explanation of the operation of this amplifier follows.

For simplification the single tube in the actual circuit is shown in the diagram Figure 7 as separate triodes "A" and "B." At balance condition the input voltage from the measuring circuit which is applied to the grid of the first triode is zero. Under this condition "A" and "B" pass a steady d-c plate current which is determined by the characteristics of the tubes and by the values of d-c voltage and plate resistance R1 and R6.

Consequently, d-c voltages appear across plate resistors R1 and R6 and between plate and cathode of each tube. No d-c voltage appears on the grid of tube "B" and across the output resistor R8 since the "blocking" condensers C6 and C7 prevent any d-c from flowing in these circuits.

Now assume that the measuring circuit is unbalanced as for example by a change in temperature of the element in the pyrotron bridge. An alternating voltage e_{g1}, having a magnitude proportional to the amount of unbalance and a phase relation to line voltage depending on the direction of unbalance, is

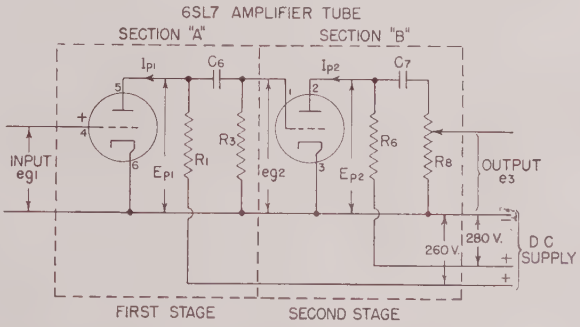


FIGURE 7 — Voltage Amplifier Diagram.

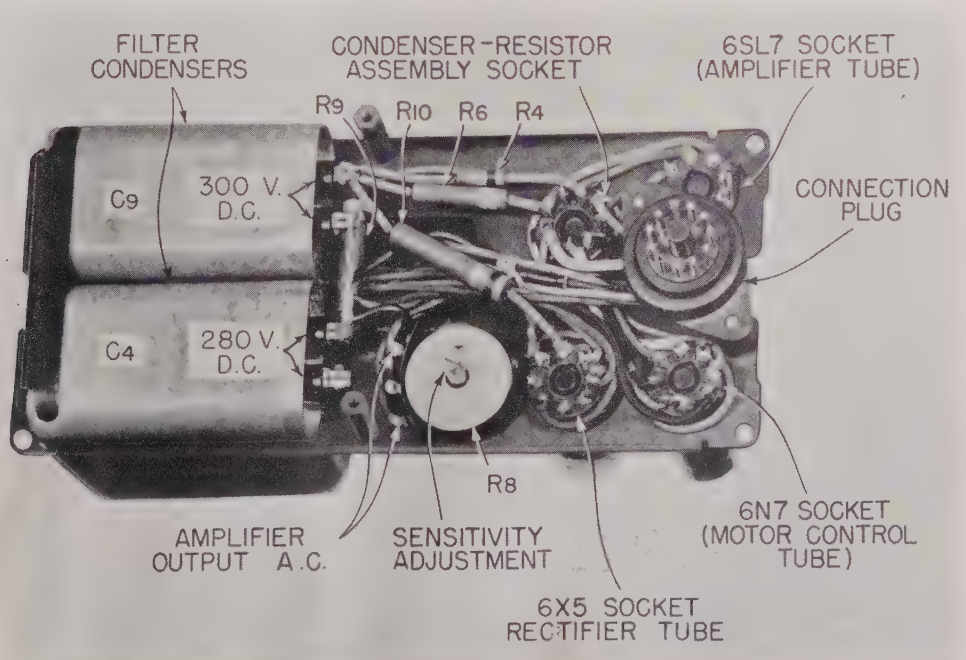


FIGURE 6 — Under side of Amplifier Chasses.

impressed on the grid of tube "A." Since this voltage is alternately positive and negative, it causes corresponding variations in the plate current I_{p1} of tube "A."

Negative grid voltage reduces the plate current and positive grid voltage increases the plate current as shown graphically in Figure 8. These variations in I_{p1} cause an a-c voltage drop to be superimposed on the existing d-c voltage drop through resister R_1. This a-c component of voltage across R_1 is in phase with the grid voltage. Since the voltage across R_1 plus the voltage between the plate and cathode of the first triode, (E_{p1}) must equal the steady d-c supply voltage, it follows that the voltage E_{p1} must also have an a-c component equal in magnitude and opposite in phase to the voltage across R_1. The magnitude of this a-c component is proportional to the product of the amplification of the tube and the grid voltage.

The blocking condenser C_6 passes only the a-c component of the plate voltage E_{p1} which is applied across the resistor R_3. This is output voltage e_{g2} of the first amplifier stage which is applied to the grid of the second stage where it is amplified and appears as output e_3 across the rheostat-potentiometer R_8.

Since phase reversal occurs in each stage the output voltage of the amplifier is in phase with the input voltage.

MOTOR CONTROL CIRCUIT

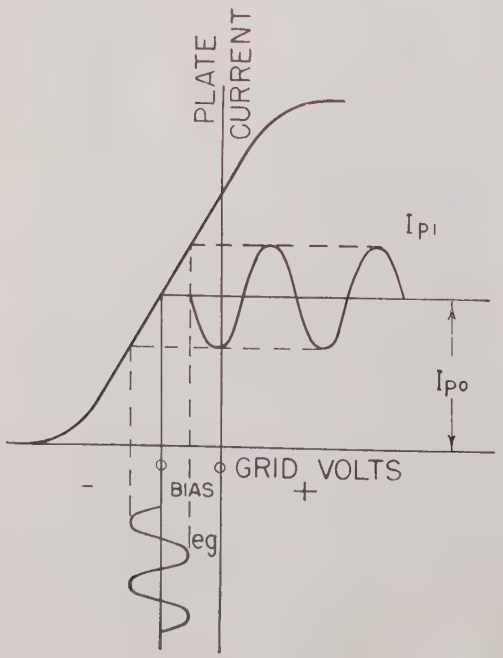
The amplifier output is applied to the motor control circuit which controls the direction of rotation and speed of the reversing motor which drives the slidewire.

The electronic circuit which controls this motor is shown in Figure 9. Direction of rotation of the motor M is controlled by the two saturable core reactors "A" and "B." The flow of direct current through the saturating windings of these reactors is controlled by the double triode tube 6N7.

Motor M is a "capacitor run" type having two identical windings W_A and W_B 90 electrical degrees apart on the stator. The operation is similar to that of a two-phase motor and rotor torque is developed by displacing the current in the windings W_A and W_B in time phase relative to each other. The direction of rotation is determined by whether the current in W_A is leading or lagging the current in W_B. Consequently, the speed with a constant load is proportional to the magnitude of the winding currents and the phase displacement between them. This motor is of special design to permit rapid braking when the winding currents are brought into phase.

Supply voltage to this motor circuit is boosted to 160 volts from the normal 115 volts source by means of the auto transformer connection to the primary winding of the supply transformer. This permits rated power to be obtained from the motor in spite of the voltage drop through the reactor.

The voltage applied to the 6N7 plates is obtained from a center tap secondary winding of the supply transformer. The grids are connected together and receive their voltage from the measuring or control circuit either through a voltage amplifier or by direct connection. It is a fundamental requirement that the plate supply for the 6N7 be obtained from the same source and phase as the grid input signal. For this application the source is the 115 volt 60 cycle supply to which the motor is connected. However, the power supply to the motor can be entirely divorced from the control circuit.



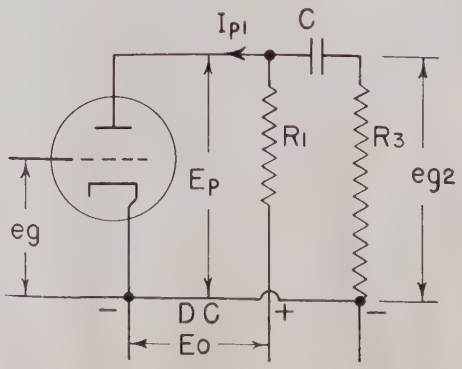


FIGURE 8 — Amplifying characteristics of Triode Tube.

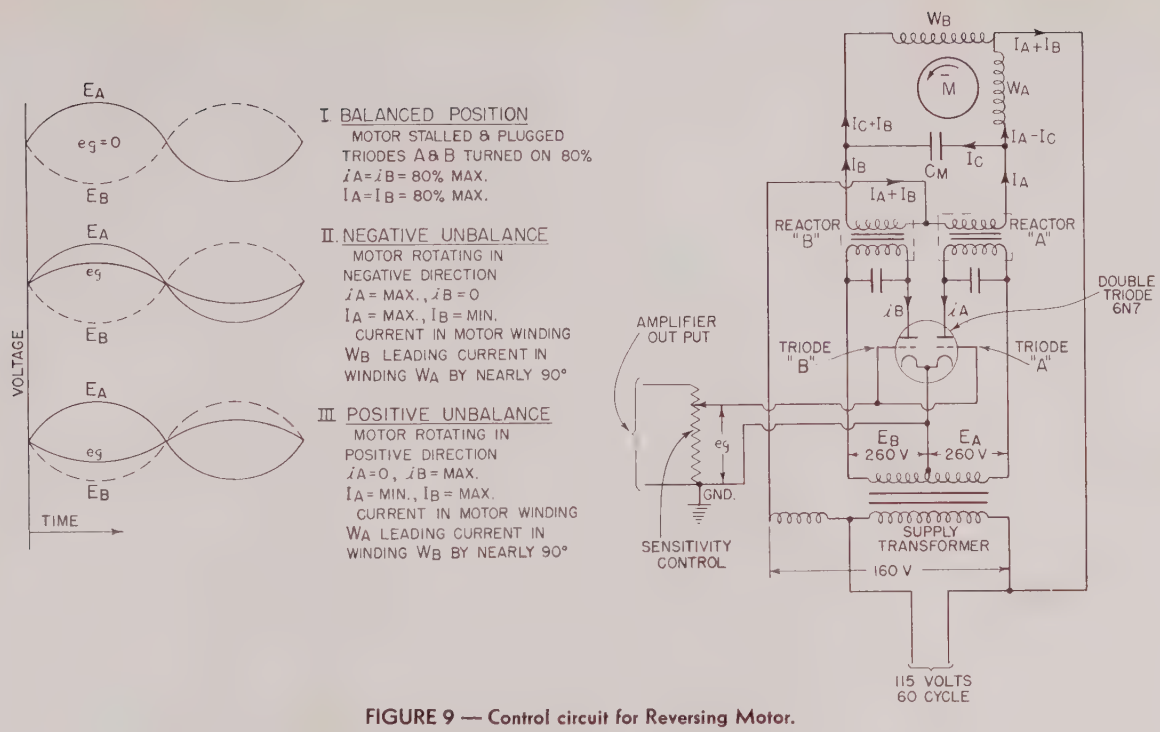


FIGURE 9 — Control circuit for Reversing Motor.

Since the plates of the 6N7 are 180° out of phase with each other and the grids are in phase, the plate currents of the two sections of this tube are selectively controlled by phase relation between the grid voltage and the plate voltage. In the balanced position with zero grid voltage the triodes "A" and "B" conduct about 80% of their maximum plate current. In this case the reactors "A" and "B" are saturated equally and equal and in-phase currents flow from the line through the motor windings W_A and W_B. These in-phase winding currents restrain the motor from rotating.

Now assume that the measuring circuit is unbalanced by change in the measured variable to produce a grid voltage eg in phase with the plate voltage of triode "A" and 180° out of phase with the plate voltage of triode "B." If the signal is large the plate current iB becomes zero and iA reaches its maximum value. Reactor "B" is desaturated and reactor "A" is saturated to its maximum value. The flow of line current is then through reactor "A" directly into motor winding W_A and through the capacitor C_M into winding W_B. In this case the current in winding W_B leads the current in winding W_A by nearly 90° and the motor rotates in a negative or counter clockwise direction.

As the motor drives the slidewire contact to rebalance the measuring circuit, the grid voltage eg is gradually reduced. When the slidewire moves to within 1% of the balanced point, the current i_B increases and i_A decreases until they become equal. In this region of control considerable braking action is exerted on the motor since the phase displacement between the motor winding currents approaches zero. In a similar manner an unbalance in the measuring circuit to produce a grid voltage eg in phase with the plate voltage of triode "B" will cause the motor to rotate in the opposite direction.

In general the sensitivity of the system is sufficient to develop about 75% of the maximum motor torque with about .002 volts input to the amplifier. This corresponds to about .00015 volts unbalance of the Wheatstone Bridge or approximately 0.1° F. change in temperature of the Pyrotron element when the bridge output transformer is used. The curve, Figure 10, shows the relation between stalled motor torque and amplifier input.

VACUUM TUBE REPLACEMENT

Vacuum tubes should be periodically checked on a vacuum tube tester and replaced when required, as indicated by very low transconductance of the 6SL7 and the 6N7 and by poor emission of the 6X5. If no vacuum tube tester is available, trouble-free service may be insured by replacing tubes once each year.

HIGH AMBIENT TEMPERATURE

The amplifier will operate satisfactorily in ambient temperatures as high as 120° F. Higher temperatures may cause rapid deterioration of the condensers and of coil and wire insulation. They should be avoided.

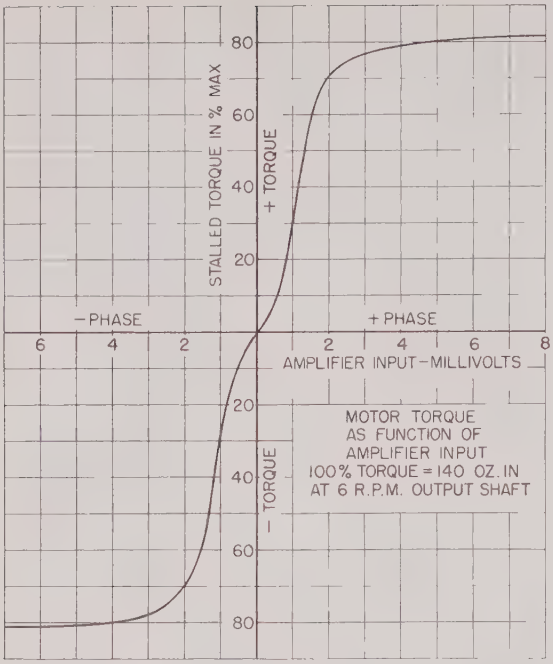


FIGURE 10 — Relation between stalled motor torque and amplifier input.

VOLTAGE AND FREQUENCY VARIATIONS

The amplifier is designed to operate from a 115 volt, 60 cycle supply. Line voltage variations from 105 volts to 125 volts, and frequency variations from 58 to 62 cycles per second will have no serious effects on the accuracy and sensitivity.

Line voltage below 105 volts will result in loss of sensitivity and possible sluggish operation of the recording motor.

Voltages above 125 volts may cause excessive heating in the amplifier and in the recording motor, particularly in high ambient temperatures.

DUSTY AND WET LOCATIONS

The amplifier is made reasonably water and dust-tight and no trouble will be encountered in the average location from these factors. Extremely wet or dirty locations should be avoided since an accumulation of dust and moisture on the wiring, contacts, and parts may cause excessive electrical leakage and eventual breakdown.

If the amplifier is subjected to prolonged water splashing, it may be necessary to dry the unit in an oven before attempting to place it in operation. Drying at 230° F. for an hour or more should be satisfactory. Higher temperatures may cause charring of insulation and may melt the compound in the reactor casing.

TEST FOR FAULTS

The cause of defective operation or failure to operate should be definitely traced to the amplifier before any detailed check of this unit is attempted. The simplest and best way to do this is to replace the defective amplifier with a spare unit. If such a spare is not carried in stock, it may be borrowed from one of the other recording circuits in a multi-pen recorder, or from another receiver. If no spare amplifier is available, refer to the trouble-shooting chart for the type of meter being tested.

If the recorder functions with the spare amplifier, it is fairly obvious that the first amplifier is defective.

If the meter fails to operate with the spare amplifier which is known to be in good condition, it indicates that the source of trouble is elsewhere and the receiver and external wiring should be checked.

INSPECTION AND OPERATIONAL CHECKS

Observe if the cathode heaters are glowing in the 6SL7 and the 6X5 glass tubes and if the 6N7 metal tube is warm. If none of these tubes appear to be excited, it is probable that the amplifier is not receiving power from the 115 volt supply. If one of the tubes is not excited, replace it with a spare tube.

If the heaters are lit, the tubes may still be defective because of shorts between electrodes, lack of cathode emission, etc. Replace the tubes in the defective amplifier one by one with tubes that are known to be good.

Replace the condenser-resistor assembly which plugs into the socket on the amplifier chassis with a spare unit or one from a good amplifier.

If these checks do not reveal the source of trouble, remove the amplifier from the back of the meter casing and from its own housing for inspection. Check for shorts between prongs on the tube sockets, broken connections to these sockets, broken wires and the like. Observe if the two filter condensers, C4 and C9 mounted on the underside of the chassis have developed leaks, as indicated by a film of Pyranol on surrounding surfaces.

A burned or charred appearance in the R10 resistor (see Figure 6) which is in series with the cathode of the 6X5 rectifier tube, indicates a ground or short in the d-c power supply.

Excessive heating of the power supply transformer (see Figure 4) as indicated by the laminations becoming too hot to touch, or by wax or smoke emanating from the coil, indicates a defective transformer or a short or ground in the wiring.

Unless the source of trouble indicated by these symptoms is in the external wiring or in the tube socket connections and can easily be repaired, the entire amplifier unit should be replaced and the defective unit returned to the factory.

TUBE TESTING

Tubes may be tested for faults by means of standard radio tube testing equipment. Defective tubes should be replaced.

CIRCUIT TESTING

If a spare amplifier is not available and if the preceding operational checks and inspections fail to remove the trouble, the cause may lie in the amplifier circuit or in one of its components. If a complete check on the external system including the motor and the measuring circuit reveals no trouble there, it is recommended that the amplifier be returned to the factory.

If one is familiar with electronic circuits and equipment and has the necessary test equipment, he can make further checks with an instrument which should indicate definitely if the trouble is in the amplifier. Such tests may indicate the exact location of the trouble which, in some cases, may be of a nature as to be easily repaired even though it was not detected by visual inspection.

A volt-ohmeter of the type used by radio repair men and an eleven-wire cable having suitable plugs at each end, so that the amplifier can be operated when removed from the meter casing, are required. The meter should be of the multi-range type suitable for measuring both a-c and d-c. It must also have an internal resistance of 1000 ohms or more per volt to enable it to be used on high impedance circuits.

The following test should be useful in locating the source of trouble. Check points referred to are indicated on Figure 6, which shows the under side of the chassis.

CAUTION **—** Because of the high voltage across some parts of the amplifier circuit, testing of this kind with the amplifier energized and "live" parts exposed involves considerable danger to the tester and the equipment.

1. ***Test D-C Power Supply*** — The total d-c voltage can be measured by connecting the meter across the terminals of condenser C9. This should read 280 to 300 volts, providing the meter has a resistance of 1000 ohms per volt a-c and 5000 ohms per volt d-c.

The d-c voltage applied to the plate circuit of the first amplifier stage is read by connecting the meter across C4. This should be 260 to 280 volts.

No voltage or a very low voltage across C9 indicates a defective power supply circuit or a defective 6X5 tube. To localize the trouble, first check the 6X5 tube in a tube tester or replace it with another known to be good. Next, measure resistances R10 (5,000 ohms), R4 (50,000 ohms) and R9 (100,000 ohms). Then measure a-c voltages from contact 3 and from contact 5 on the 6X5 socket to ground. These should both measure approximately 260 volts. No voltage or very low voltage indicates a defective power transformer.

2. ***Test Amplifier*** — If the test meter has a low voltage a-c scale, the amplifier input can be checked by connecting the meter from No. 4 contact on the 6SL7 socket to ground. Rotate the slidewire by hand and observe the meter reading. As the balance point of the bridge is approached, the voltage decreases smoothly, reaching zero or a minimum at balance and increases again on the other side. This input voltage is small on the Pyrotron and will probably never exceed a volt. On the Telemeter it may amount to several volts.

The output of the amplifier which is the input to the 6N7 motor control tube, can be obtained by measuring the a-c voltage from the center contact of the sensitivity adjustment rheostat-potentiometer, R8 to ground. This voltage will measure a maximum of 30 volts, or more, except for zero or very small input to the amplifier. It will increase smoothly as the sensitivity adjustment is turned in a clockwise direction and will go to zero when the input to the amplifier is shorted by connecting contact No. 4 on the 6SL7 socket to ground. On Pyrotrons as the slidewire is turned to the balance point, this voltage will decrease to a minimum or to zero. On Telemeters this minimum output may be hard to detect. If this is the case, the shorted input check described previously, can be used as an indication of operation.

3. ***Test Motor Control Circuit*** — If the previous tests indicate that the amplifier section is in satisfactory condition and that the motor is in operating condition (see Section E85 on slidewire unit for motor tests), it is likely that the trouble is in the motor control tube or circuit.

Test the 6N7 tube or replace it with one that is known to be in good condition. If no tube or tester is available, the operation of the 6N7 tube and the d-c circuit through the saturable reactors can be tested by measuring the voltages across the reactor control coils. Measure these voltages from contact No. 3 on the 6X5 tube to contact No. 3 on the 6N7, and from contact No. 5 on the 6X5 to contact No. 6 on the 6N7.

With zero amplifier input as obtained by balancing the measuring circuit or by shorting the amplifier

input, both these measured voltages should be equal at about 18 volts.

If the slidewire is moved in one direction, one voltage should increase and the other should go to zero. When the slidewire is turned in the other direction, these voltages should change in the reverse manner.

If any of these tests indicate a defective amplifier unit that cannot be repaired by simply replacing a tube or the condenser-resistor assembly, or by repairing a connection, the entire unit should be returned to the factory for replacement by an exchange unit.

SPARE PARTS

When continuity of service is important it may be desirable to provide a spare amplifier unit part No. 661800 complete and ready for service.

Usually the following spare parts will suffice:

1 — 6SL7 Tube for each 4 amplifiers
1 — 6X5 " " " " "
1 — 6N7 " " " " "
1 — Condenser-Resistor Assembly part No. 661730 for each 8 amplifiers.

When ordering parts be sure to specify the serial numbers of receivers on which they are to be used.

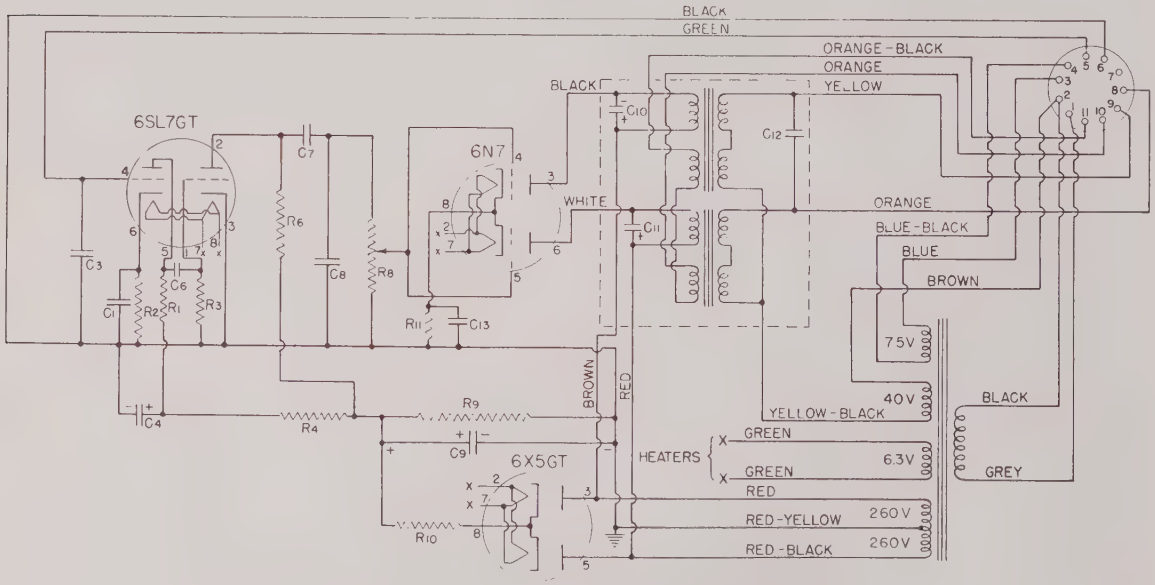


FIGURE 11 — Complete Wiring Diagram of Amplifier Unit.

C_1, C_{13}	— 25 mfd.	25 v. d.c.	R_1	— .5 meg.
*C_3, C_6	— .05 mfd.	600 v. d.c.	R_2	— 2000 ohms
C_4, C_9	— 4 mfd.	330 v. a.c.	R_3	— 1 meg.
C_8	— .006 mfd.	600 v. d.c.	R_4	— 50,000 ohms
C_7	— .10 mfd.	600 v. d.c.	R_6	— 250,000 ohms
C_{10}, C_{11}	— 1 mfd.	500 v. d.c.	R_8	— .5 meg. pot.
C_{12}	— 1.25 mfd.	220 v.	R_9	— 100,000 ohms
			R_{10}	— 5000 ohms
			R_{11}	— 500 ohms

*C3. = 006 mfd., 600 v. d.c. for low range and d.c. Pyrotrons using Bridge Output Transformers.

FOR THE ADJUSTMENT AND MAINTENANCE OF

MOTOR DRIVEN SLIDEWIRE UNITS

GENERAL DESCRIPTION

The slidewire unit used with Bailey Electronic Type Instruments is shown disassembled in Figure 1. The unit is supported by a die cast motor bracket which attaches to the instrument casing or the inner door. Mounted to this bracket is a capacitor run type reversing motor with an integral gear reduction housing. The motor output shaft extends through the bracket and carries a leaf spring type friction clutch and clutch housing which in turn carries the slidewire disc.

Any backlash in the motor reduction unit is eliminated by a spring in the motor bracket which engages with the driving clutch housing.

The slidewire is carried on a molded disc secured to the clutch housing by means of a disc clamp whose mounting screws are accessible through the larger holes in the pointer drive cam. Travel limit stops consisting of eccentric screws in the molded disc engage a boss on the motor bracket. These permit travel of the slidewire contact to the extremes of the wound portion of the slidewire.

In some cases not all of the slidewire motion is used for full scale deflection. In these cases the maximum auxiliary stop is added to the disc and adjusted to limit maximum travel as outlined later.

By shaping the pointer drive cam at calibration, the desired relation between slidewire motion and indicator or recording pen travel is secured. The cam is attached to the clutch housing and is held in proper relation with the slidewire disc by means of a single dowel. This cam actuates the pointer drive arm which has its supporting shaft bearings in the motor bracket. An adjustable lever is attached to this system to actuate the linkage for the recording pen or indicating pointer.

The slidewire disc is arranged to support either one flat tapered slidewire or one or two round slidewires. The resistance value of the slidewire is adjusted to the approximate value for the measuring circuit by the selection of wire size. Further calibration is obtained by the calibration spools of the terminal block assembly.

When high or low limit contacts are desired, an alarm contact cam is added to the slidewire disc and adjusted to operate a Micro switch assembly.

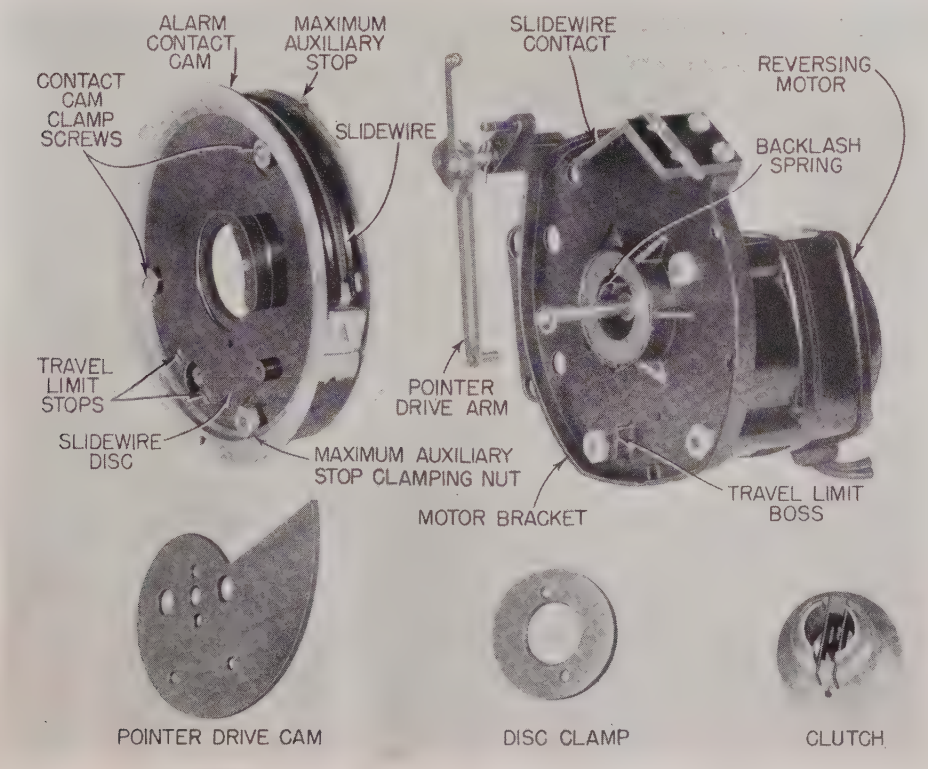


FIGURE 1 — Principal parts of Motor Driven Slidewire Unit

ELECTRICAL CONNECTIONS

Figure 2 shows the method of making electrical connections to the slidewire unit. It will be noted that all wires which connect the unit to the meter case terminals are run in a single cable which is connected to the terminal block assembly at the slidewire unit. One wire of the cable connects directly to the slidewire contact spring while all others are attached to the terminal block.

Motor lead wires are color coded and are provided with lugs connecting them to marked terminals so that these leads may be readily removed when dismantling the assembly for motor inspection or other purposes. The flexible lead wires between the terminal block assembly and the slidewire disc are secured to the motor bracket and coiled around the drive clutch housing to provide sufficient slack for rotation of the slidewire disc.

Calibrating resistor spools are permanently soldered to the lugs on the terminal block assembly.

The actual color coded wiring diagram showing connections is included in the Instrument Circuit Section of these instructions.

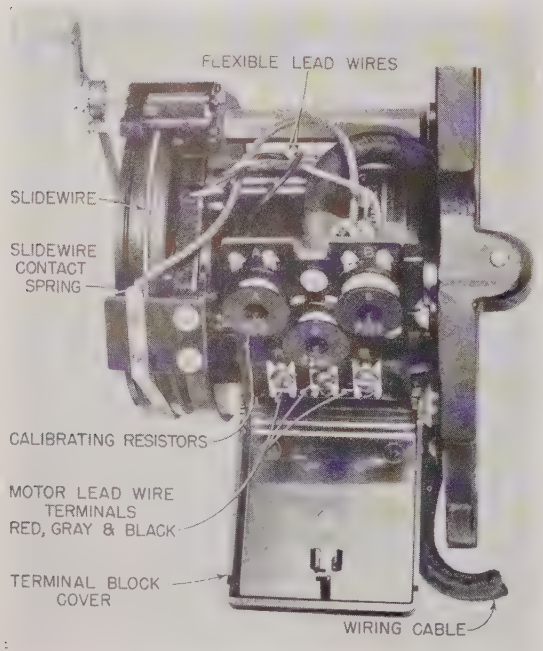


FIGURE 2 — Slidewire Unit Terminal Block with protecting cover turned back

DISASSEMBLY

When disassembling the slidewire unit for inspection of the unit or for motor maintenance, the following steps should be followed:

1. Disconnect linkage between drive arm and recording pen, indicating pointer, or control pilot.

2. Remove pointer drive cam by taking out its two mounting screws. The dowel pin remains in the disc.

3. Remove the disc clamp by removing the two screws which secure it to the clutch. The slidewire disc will now be loose and should be carefully handled to avoid damaging the flexible lead wires which connect it to the terminal block.

4. Do not attempt to remove the slidewire from the molded disc. Always handle this assembly with care so as not to damage the windings.

5. Disconnect the motor leads from the terminal block. Free the motor bracket of all electrical connections by disconnecting the lead wire from the slidewire contact and removing the small wire clamp which secures the flexible red and black lead wires to the motor bracket. The motor, bracket, and clutch assembly may now be removed without opening any additional electrical connections. Disassembly of the motor and clutch can be continued on a convenient bench.

6. The clutch housing may be removed from the motor shaft by removing the pin and ring keeper. Turn the clutch housing in a counterclockwise direction until all tension exerted by the backlash spring is removed. Work the clutch housing back and forth as it is pulled from the motor shaft. In case the clutch leaf spring slips out of the clutch housing during this process, it can be restored to proper position simply by pushing it back into the slots provided in the housing.

7. The backlash spring should be left in its recess in the motor bracket unless it is absolutely necessary to remove it for inspection or renewal. This spring will be pulled off with the clutch housing unless its backlash tension is removed according to the procedure outlined under point 6.

8. The motor can be removed from the motor bracket and further disassembled by loosening the four bolts to the corners of the frame. Flush used oil from the gear reduction housing and clean with gasoline or similar solvent. Upon reassembly add oil in accordance with the motor maintenance instructions.

REASSEMBLY

1. To reassemble, follow the above instructions in the reverse order and observe the following precautions.

2. When the clutch is installed on the motor shaft, engage the clutch extensions with the backlash spring and rotate approximately 1½ turns in a clockwise direction to provide the proper backlash spring tension.

3. When installing the slidewire disc, fasten the flexible lead wires to the motor bracket with the screw and wire clamp provided and coil three turns

of the lead wires around the clutch housing in a clockwise direction. Make sure that these wires are free to move with the slidewire before mounting the disc on the clutch housing.

4. The drive cam will mount on the assembly in only one position when the dowel pin is properly engaged and the cam designation markings are visible.

5. Check the maximum and minimum stop positions to make sure that the slide contact is engaging the wire at each extreme. Finally check the setting of the indicating pointer or recording pen when the slidewire is against the minimum stop.

ADJUSTMENTS

The Zero Travel Limit Stop is adjusted at the factory during calibration and ordinarily should not be changed.

The Maximum Stop is set to allow approximately 2% cam or indicating pointer travel beyond the maximum point on the scale or chart. To adjust these limit stops, loosen the lock screw between the two travel limit stop screws and rotate the proper stop screw until the correct travel of the slidewire is obtained.

The Backlash Spring is adjusted so that all backlash in the motor gear reduction unit is taken out in one direction at all times regardless of the position of the slidewire disc. The operation of the spring can be checked by rocking the slidewire slightly at either extreme of travel. If there is not enough tension in the spring to eliminate backlash completely at either extreme, turn off the power supply switch and rotate the slidewire disc to the mid position manually. Remove the drive cam and slidewire disc from the clutch housing. Turn the clutch housing through one complete revolution in a clockwise direction. Replace the drive cam and slidewire disc. This provides more tension in the backlash spring. If more than three turns of the backlash spring are required to eliminate backlash, then there is excessive friction in the motor gear reduction unit and the motor should be removed for inspection and overhaul.

The Slidewire Contact should engage the slidewire lightly over its entire travel. This contact member consists of a gold alloy mounted on a beryllium copper spring. Proper spring tension is obtained by bending the spring until the free position of the contact is approximately 1/8-inch closer to the motor shaft than when engaged on the slidewire. This setting can be checked by removing the slidewire disc.

Linkage between the slidewire unit and the recording pen or indicating pointer is adjusted at the factory to give the proper calibration. Links are provided with a spring retainer type of bearing to hold them in place on the pivots without excessive backlash or friction. Links may be disconnected by snapping them off the pivots with the fingers or a small screw driver and are reinstalled in the same manner. The length of the adjustable lever on the pointer drive arm is set during calibration but if full travel of the slidewire disc does not give full scale deflection, the length of the lever may be altered to suit.

A Maximum Auxiliary Stop is used on certain types of instruments where not all of the slidewire motion is required for full scale deflection. In making the adjustment of this auxiliary stop, the clamp nut on the front side of the slidewire disc is loosened and the stop backed off to allow approximately full motion of the slidewire disc. After the driving linkage is adjusted to obtain the proper calibration of the combined transmitter and receiver, the maximum auxiliary stop ring is rotated on the disc until motion of the slidewire is limited at a point approximately 2% above full scale deflection of the receiver.

The Alarm Contact Cam is held in position by the contact cam clamp screws on the front side of the slidewire disc. When setting the alarm contacts, cut the power switch and set the instrument at the desired tripping point by rotating the slidewire manually. Loosen the contact cam clamp screws and rotate the contact cam until the switch operates. Tighten the clamp crews and check the setting by rotating the slidewire to the trip point and observing the position of the recording pen or indicating pointer.

MAINTENANCE

The motor used with this unit should operate satisfactorily for several years without reoiling or further attention unless excessively high ambient temperatures exist. For high operating temperatures, it may be necessary to lubricate the motor every six months. The gear case should be reoiled with SAE No. 10-W. Approximately one-half teaspoonful is required in the gear case and about 15 drops should be added to the motor bearing oil hole.

In case the slidewire or contact becomes dirty, wipe off the assembly with a clean cloth. The cloth may be dampened with carbon tetrachloride to remove heavy deposits. When operating the unit in corrosive atmospheres, a very thin coating of vaseline on the slidewire will be helpful in keeping down corrosion.

The driving linkage must be free of backlash and friction in order to insure proper operation of the instrument. Inspect all parts for alignment when overhauling the instrument. The tension coil spring should hold the pointer drive arm against the cam at all positions of the slidewire.

SPARE PARTS

Since none of the parts of this unit are subjected to any serious wear or other deteriorating effects, it should not be necessary to carry spares. For large users of these instruments, it is sometimes advisable to carry a spare motor Part No. 194937D1, which will permit interchanging motor units for regular inspection or overhaul.

Oil should be added to the gear case by removing the oil hole cover screw in the upper side of the gear casing. The motor front bearing is lubricated from the gear casing and oil should be applied to the rear bearing through the oil hole provided for that purpose.

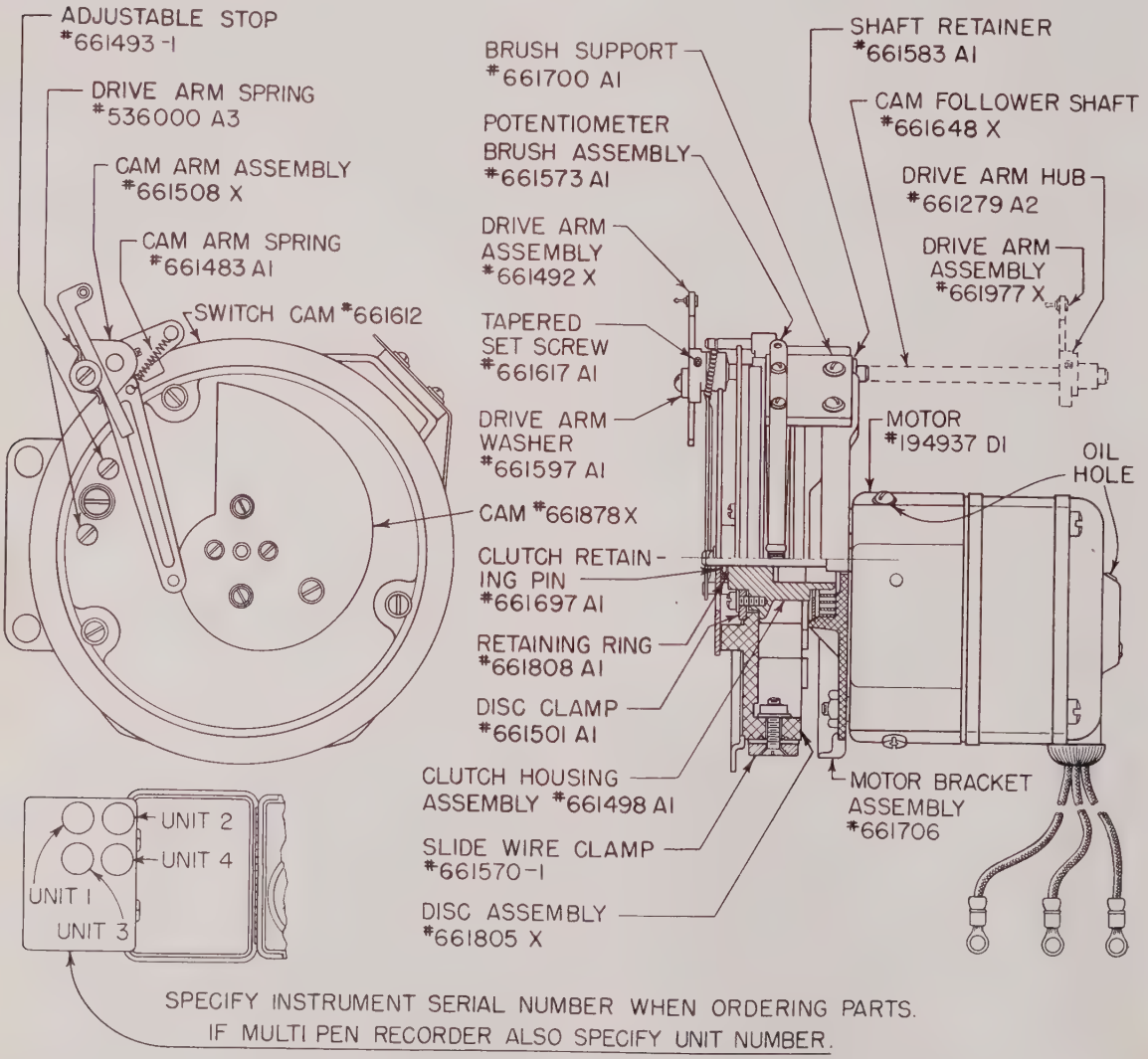


FIGURE 3 — General Assembly and Parts

Printed in U. S. A. M 9-44

INSTRUCTIONS FOR BAILEY AIR OPERATED CONTROL

SECTION AC 001
CONNECTING PIPING, REDUCING VALVES, COMPRESSORS AND FILTERS

CONNECTING PIPING

The air-operated control pipe connections should be made in accordance with the piping diagram specified on the data sheets. It is recommended that copper tubing be used entirely to eliminate the presence of scale, rust, or white lead which may give trouble when iron pipe is used. Tighter joints, which will not loosen under vibration or stress, can also be obtained with copper tubing and as relatively small quantities of air are used in the system, small leaks can cause appreciable trouble. The small clearances necessary in the pilot valves make it essential that the air supplied them be clean.

When installing tubing, care should be taken hat all joints are properly flared. If the proper precautions are taken when making the flare; that is, to have the ends even, smooth and clean, a pressure tight joint is assured and this joint may be disconnected and reconnected a number of times without danger of leaks. *Clean the inside of each length of tubing thoroughly before installation.*

All main headers should be supported sufficiently to prevent sagging and should be sloped toward the main line filter or suitable drip pockets in order that water and oil will not collect in the line and be transmitted to the pilot valves. In general, it will not be found necessary to slope the connecting piping between the controllers and control valves or drives, although low points and sags should be avoided as much as possible.

In most cases ¼″ O. D. copper tubing is of sufficient size to supply two control drives, valves, or controllers. Where the control consists of a number of units, the proper sizes to use will be found marked on the piping diagram. All loading and control lines between the various pieces of equipment should be of ¼″ O. D. copper tubing, and no larger.

It is essential to test for air leaks before the control is placed in operation. Apply air pressure of at least 40 lb. per sq. in. to the complete piping system and test each joint with a solution of soap and water. Relatively small leaks in the piping may cause erratic operation of the control, therefore, it is decidedly worth while to spend a little extra time in making sure that all piping is installed correctly and that no leaks are present.

AIR COMPRESSORS

When an air compressor is furnished as a part of the control system, complete instructions for installation and operation are shipped with the unit.

It is recommended that the pressure switch be so adjusted that the compressor will cut in when the pressure drops below 80 lb. and cut out at 100 lb.

The air receiver should be blown down frequently and kept free of oil or water. Water or oil vapor in the system will cause trouble and require frequent cleaning of the pilot valves.

The air supply connection should be made at the top of the receiver tank or to risers connected to the top side of supply headers.

REDUCING VALVES

Reducing valves similar to Figure 1 are furnished with the control system. They should be installed in a horizontal line with the adjustment screw on top. The valves furnished are suitable for air at 80 to 100 lb. initial pressure, 20 to 60 lb. outlet pressure. The size of valve furnished depends upon the requirements of the installation, but are ordinarily ⅜″, ¾″ or 1″.

The valves should be adjusted to carry the supply pressure indicated on the data sheet. This is normally either 35 or 40 lb. Turning the adjusting screw clockwise, increases the outlet pressure which the valve will maintain.

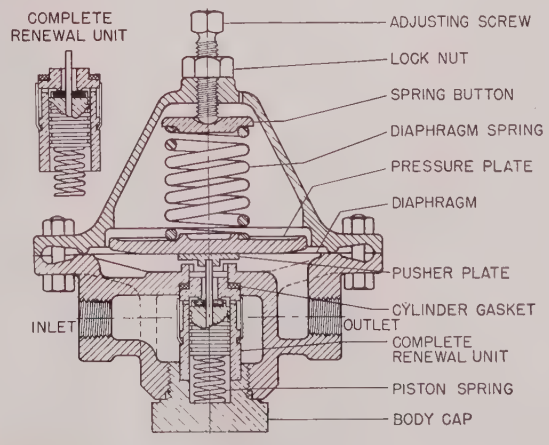


FIGURE 1

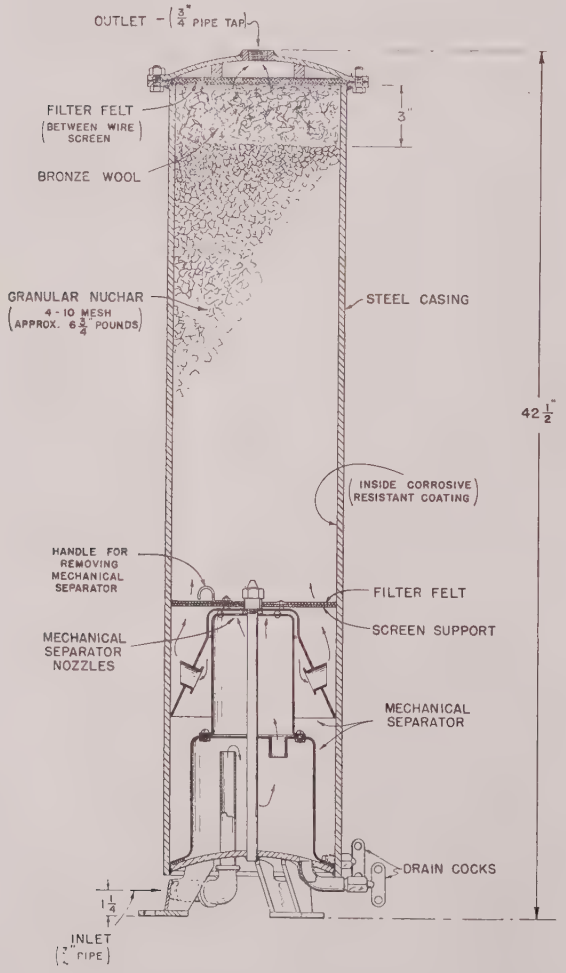
FILTERS

One or more main line filters as shown in Figure 2 are furnished with each control system. The correct method of installing the filters in the piping system is shown on the piping diagram.

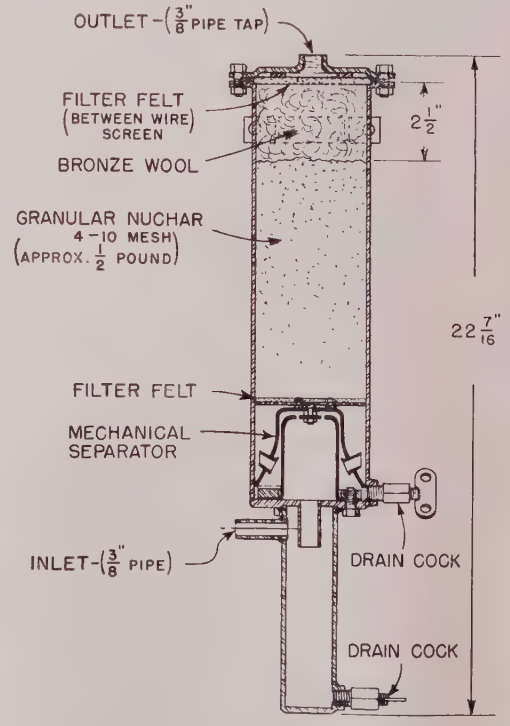
These filters are equipped with mechanical separators in addition to a filtering medium composed of felt, nuchar and bronze wool to remove all entrained oil, water and solid matter. Each filter is equipped with two drain valves which are connected to the two liquid traps in the filter. These drain valves should be opened daily to remove the accumulation of moisture or more often if the accumulation is excessive.

The charge of nuchar should be replaced every six months or more often if a noticeable amount of pilot valve fouling is evident. To remove the used charge of nuchar, disconnect the filter, remove the cover plate and bronze wool, and turn the filter upside down.

Each controller or control drive which contains an air pilot valve, is equipped with a small felt cartridge filter for each connecting line to or from the pilot valve. The purpose of these filters is to keep scale, chips, etc., which may be in the piping during installation from entering the pilot valves and causing the stems to stick or bind. It should not be necessary to clean these small filters, but if they should become clogged for any reason, they can be taken apart by unscrewing the head from the body. The felt cartridge can then be removed for cleaning.



Large Filter Part No. 533757-1
Capacity 30 cfm



Small Filter Part No. 535715-1
Capacity 6 cfm

FIGURE 2

Printed in U.S.A. 5M 4-45

INSTRUCTIONS

SECTION AC 100

FOR CALIBRATION AND OPERATION OF

BAILEY PILOTROL

BAILEY METER COMPANY

CLEVELAND 10, OHIO

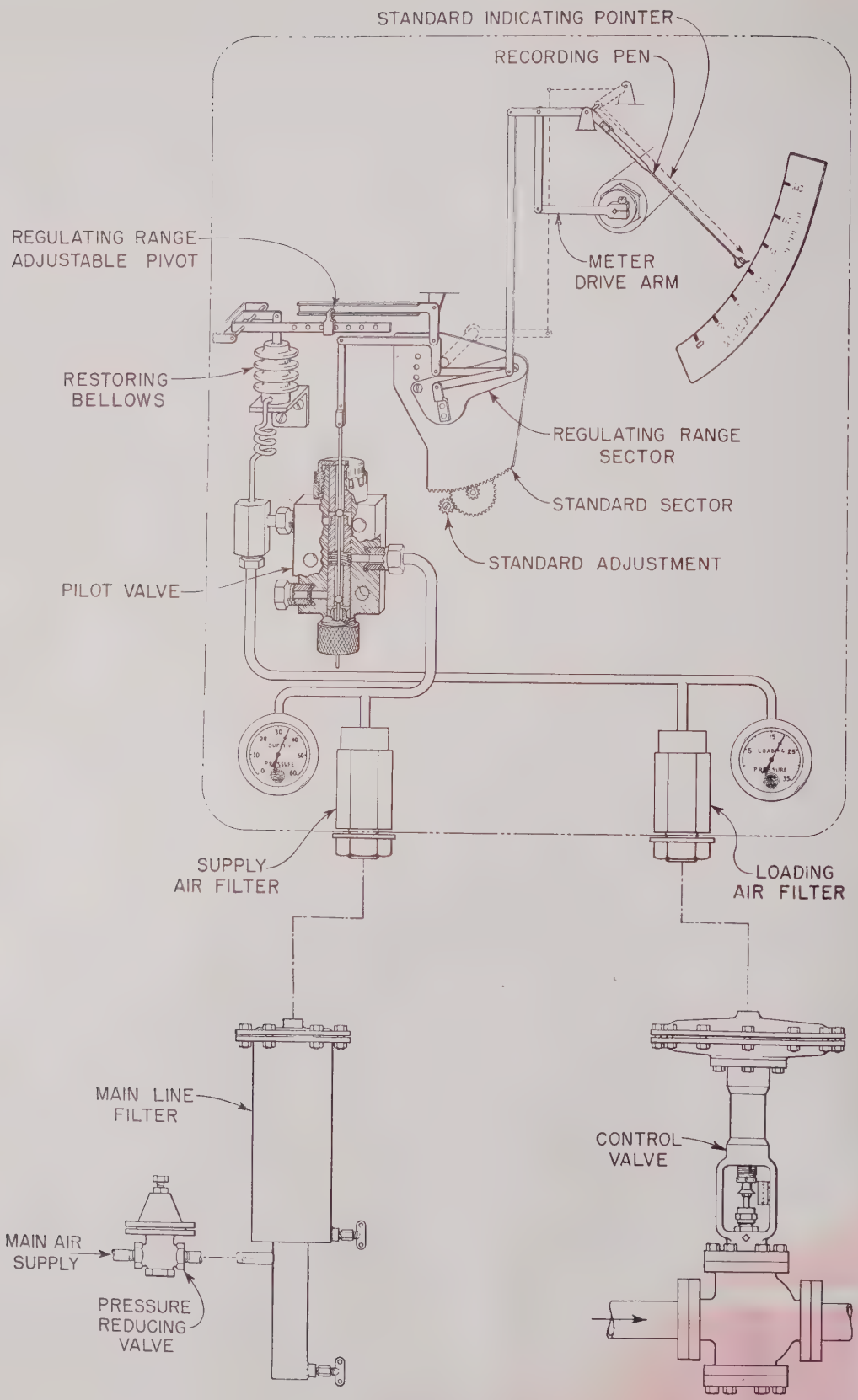


FIGURE 1
Diagrammatic Arrangement of Controller Showing Pilotrol Operation

PILOTROL

The Pilotrol is a compact assembly of a pilot valve, restoring bellows and inter-related linkage which are mounted on a base plate, and used to transform the movement imparted to the Pilotrol linkage from the drive arm of a controller meter element into air loading pressures. The Pilotrol linkage is arranged for convenient adjustment of the control "standard" and "regulating range". The restoring bellows is used to combine greater speed in loading pressure changes with stability in the control system operation.

GENERAL DESCRIPTION

Figure 1 is a diagrammatic arrangement of a simple control system. This diagram shows the Pilotrol with the "regulating range" and "standard" adjustments, the air piping and individual filters within the controller, the air supply and control air piping external to the controller and a standard control valve (or drive).

The "standard" pointer is shown dotted since it may not be included with the controller. The purpose of the "standard" pointer is to indicate on a scale or chart the value of the controlled factor which will be maintained by the controller through the operation of the control system. The "standard" pointer is connected to the Pilotrol "standard" sector so that any change in control standard adjustment will be indicated by the "standard" pointer.

The air pressures are indicated on the supply and loading pressure gages located within the controller case. The pilot valve outlet pressure is designated as either loading or control pressure. The term "control" designates the pilot valve outlet pressure when the pressure is directly connected to the control valve (or drive). If any intervening equipment such as a relay or selector valve, is used between the controller and control valve, the term "loading" is used to designate the air pressures from the pilot valve outlet to the last intervening unit. The term "Control" designates the air pressure from the last intervening unit to the control valve (or drive). The loading and control pressures do not necessarily have the same value.

PRINCIPLE OF OPERATION

An air pressure supply (normally 35 pounds), is connected to the air supply filter and passes through the filter to the pilot valve. In operation, the motion of the meter drive arm is transmitted through the pilotrol linkage to the pilot valve stem. The 35 pounds air pressure is reduced through the pilot valve to produce an air loading pressure which may vary from 5 to 25 pounds depending upon the pilot valve stem position. This range of air pressure is used to operate the control valve (or drive) through full travel.

The loading pressure change for any definite drive arm motion is determined by the position of the "regulating range" adjustable pivot and "regulating range" sector positions. A choice of either a "wide" or "narrow" regulating range is made available by providing more than one position for the regulating range sector as shown in Figure 2. The position of the adjustable pivot and regulating range sector for any desired regulating range may be determined from the characteristic curves shown in Figure 3.

The amount of loading pressure change for a given "regulating range" adjustment is determined by the variation of the controlled factor, as measured by the meter element.

Repositioning the "standard" adjustment changes the Pilotrol linkage to establish a new relation between the meter drive arm position and the pilot valve stem position. This new relation produces a change in loading pressure to reposition the control valve (or drive) and stabilize the controlled factor at a higher or lower value. The higher or lower value is determined from the direction in which the "standard" adjustment is moved.

Repositioning the "regulating range" adjustable pivot changes the Pilotrol linkage relation so that the bellows restoring action on the pilot valve stem is increased or decreased. Moving the "regulating range" adjustable pivot toward stop screw "Y" will decrease the amount of loading pressure change for the same meter drive arm motion. The bellows restoring action is reduced to zero when the "Regulating range" adjustable pivot is moved to the stop screw "X".

An adjustable cap is provided on the pilot valve body for convenient adjustment of the port sleeve alignment with the valve stem land during calibration of the Pilotrol linkage.

Reference should be made to the controller instructions for detailed information on the installation and adjustment of a specific type of controller.

Replacement part numbers for the Pilotrol assemblies may be obtained from Figure 4, Page 7.

Reprinted 5M 5-45

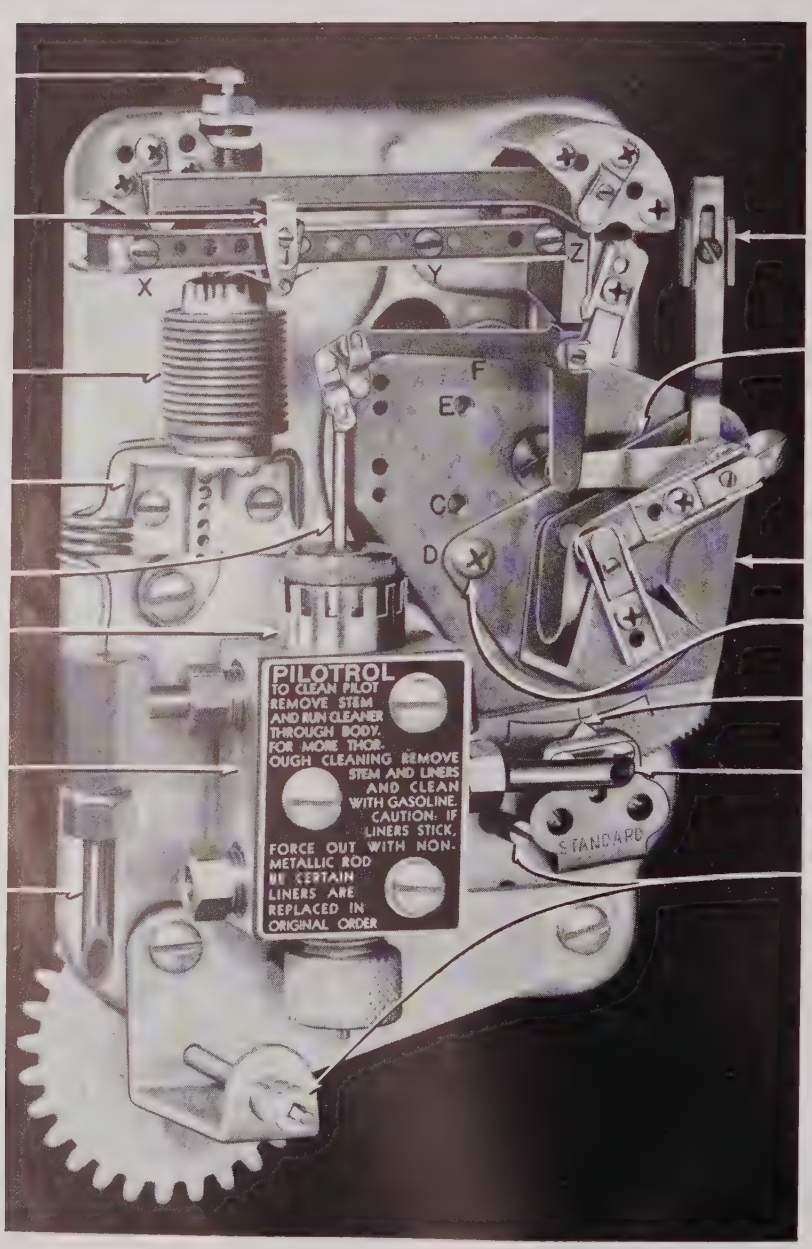

BELLOWS TRAVEL LIMIT SCREW
REGULATING RANGE ADJUSTABLE PIVOT
RESTORING BELLOWS
ADJUSTABLE MOUNTING BRACKET
PILOT VALVE STEM
ADJUSTABLE CAP AND LOCK NUT
PILOT VALVE BODY
LOADING AIR PRESSURE LINE
PILOTROL DRIVING LINK AND LENGTH ADJUSTMENT
REGULATING RANGE SECTOR ("D" OR "F" NARROW RANGE "C" OR "E" WIDE RANGE)
STANDARD SECTOR
LOCK SCREW
50% POSITION OF STANDARD ADJUSTMENT
SUPPLY AIR PRESSURE LINE
STANDARD ADJUSTMENT (USE LOWER EXTENSION WHEN PROVIDED)
PILOTROL
TO CLEAN PILOT REMOVE STEM AND RUN CLEANER THROUGH BODY. FOR MORE THOROUGH CLEANING REMOVE STEM AND LINERS AND CLEAN WITH GASOLINE. CAUTION: IF LINERS STICK, FORCE OUT WITH NON-METALLIC ROD BE CERTAIN LINERS ARE REPLACED IN ORIGINAL ORDER
X
Y
Z
F
E
C
D
STANDARD

FIGURE 2

Pilotrol Assembly

PILOTROL ADJUSTMENTS

DIRECT OR REVERSE-ACTION CONTROL

The Pilotrol linkage, as shown in Figure 2, is arranged so that by moving the "regulating range" sector across the mid-point which is half way between "C" and "E", the direction of the loading pressure as referred to the controller link motion will be reversed. Wide and narrow range sector positions are provided for either direction of loading pressure change.

If the sector is located at "C" or "D", a downward motion of the controller link will decrease the air loading pressure. If the sector is located at "E" or "F" a downward motion of the controller link will increase the air loading pressure.

Direct Acting.

When an increase in the controlled factor produces an increase in the air loading pressure, the operation of the control is considered as direct-acting.

Reverse-Acting.

When an increase in the controlled factor produces a decrease in air loading pressure, the operation of the control is considered as reverse-acting.

OPERATING ADJUSTMENT

Regulating Range Adjustment.

Move the "regulating range" adjustable pivot toward stop screw "Y" to increase the "regulating range". The slide on which the pivot is carried should be loose enough to permit easy adjustment, yet hold the adjustment after it has been completed. The adjustment is made by inserting the sharp end of a pencil in a hole beside the slide and moving the slide with a horizontal movement of the pencil.

Reference should be made to the "regulating range" curves, shown by Figure 3, for the position of the sliding pivot and sector position corresponding to the desired regulating range. If the "regulating range" sector locking screw is located at either "C" or "E", a wide regulating range is obtained. If the "regulating range" sector screw is located at either "D" or "F", a narrow "regulating range" is obtained. The range adjustment must not be moved from "C" to "E" or vice versa unless it is desired to reverse the direction of loading pressure change with reference to the controller link motion.

Standard Adjustment.

To change the operating standard, rotate the "standard" adjustment in the desired direction. If the controller is equipped with a "standard" indicating pointer, set the pointer at the desired value on the chart or scale by turning the "standard" adjustment.

CHECKING OR CALIBRATION ADJUSTMENT.

1. Move the "regulating range" adjustable pivot to left until it is against the stop screw "X".

2. Set the controller pen or pointer and "standard" sector pointer at 50% of scale.

3. Remove lock screw from the "regulating range" sector and move the sector half way between "C" and "E" so that the controller link can be moved without varying the loading pressure.

4. Turn pilot valve adjustable cap in the cap lock nut for alignment of the port sleeve with the valve stem land until 15 pounds loading pressure is obtained. It is necessary to disengage the lock nut finger from the cap groove for this adjustment. The lock nut must be tight against the valve body when completed and a finger pressed into a groove to lock the position of the cap.

5. Move the "regulating range" adjustable pivot to the limit screw "Y", and adjust the bellows position up or down until 15 pounds loading pressure is obtained.

6. Return the "regulating range"' sector and lock screw to the position which was had previous to adjustment 3. If the sector is in "D" or "F" position, locate stop screw at "Y". For "C" and "E" positions the stop screw is located at "Z".

7. Adjust the length of the controller connecting link for 15 pounds loading pressure with the controller pen or pointer and standard sector pointer set at 50% of scale.

8. Set the bellows stop screw so that bellows travel is limited when the air loading pressure is 28 pounds.

MAINTENANCE

All pivots used in the assembly of the Pilotrol are made of stainless steel and require no external lubrication.

The air connections to the pilot valve and filters must be kept air-tight. Check for leakage with soapsud solution.

Files, reamers or abrasives must never be used on the valve stem lands, sleeves of the pilot valve or the Pilotrol pivots and bearings.

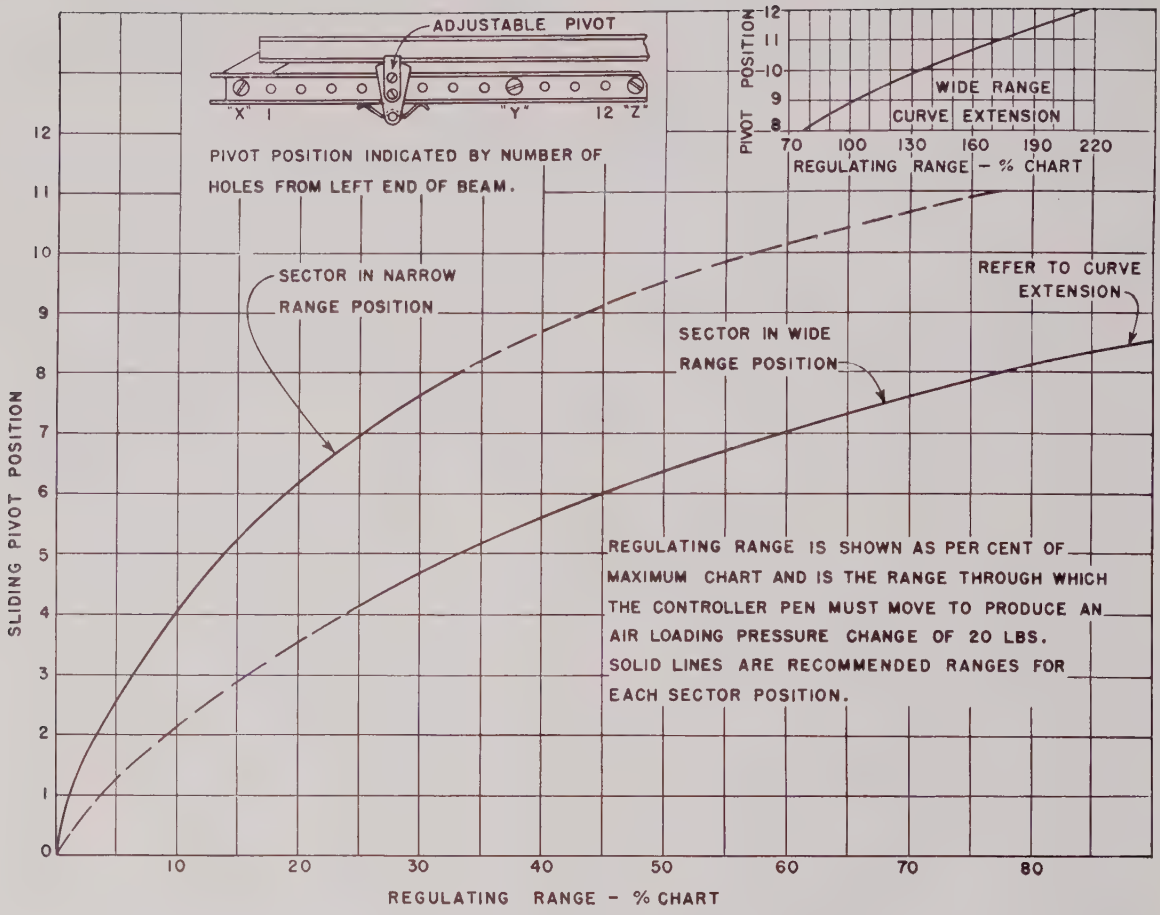

ADJUSTABLE PIVOT
"X" 1
"Y"
12 "Z"
PIVOT POSITION INDICATED BY NUMBER OF HOLES FROM LEFT END OF BEAM.
PIVOT POSITION
WIDE RANGE CURVE EXTENSION
REGULATING RANGE – % CHART
SECTOR IN NARROW RANGE POSITION
REFER TO CURVE EXTENSION
SECTOR IN WIDE RANGE POSITION
REGULATING RANGE IS SHOWN AS PER CENT OF MAXIMUM CHART AND IS THE RANGE THROUGH WHICH THE CONTROLLER PEN MUST MOVE TO PRODUCE AN AIR LOADING PRESSURE CHANGE OF 20 LBS. SOLID LINES ARE RECOMMENDED RANGES FOR EACH SECTOR POSITION.
SLIDING PIVOT POSITION
REGULATING RANGE – % CHART

FIGURE 3

Pilotrol Regulating Range Characteristic Curves.

If pilot valve is cleaned or repairs made to the Pilotrol linkage, a recalibration of the Pilotrol linkage should be made as described under calibration adjustment.

REGULATING RANGE

The Pilotrol regulating range characteristic curves are shown by Figure 3. The regulating range may be defined as the relation between the motion as imparted to the Pilotrol linkage from the controller meter element, and the loading pressure change produced by that motion. Since most Bailey Air Control Systems use a loading pressure range of 5 to 25 pounds to operate the control drives or valves through full travel, the basis for the regulating range curves in Figure 3 has been established as the amount of motion imparted to the Pilotrol linkage from the controller meter element, which is required to produce a loading pressure change of 20 pounds. The motion from the controller meter element is shown in per cent of maximum chart, or on indicating controllers this would be per cent of maximum scale. Where the range exceeds 100% chart, the loading pressure change would be less than 20 pounds for 100% chart motion.

The recommended ranges are shown by the solid line sections of the curves for both narrow and wide range sector positions.

It is necessary to limit the adjustable pivot travel by stop screw "Y" when the sector is in narrow range position in order that over-travel of the pilot valve stem will be avoided.

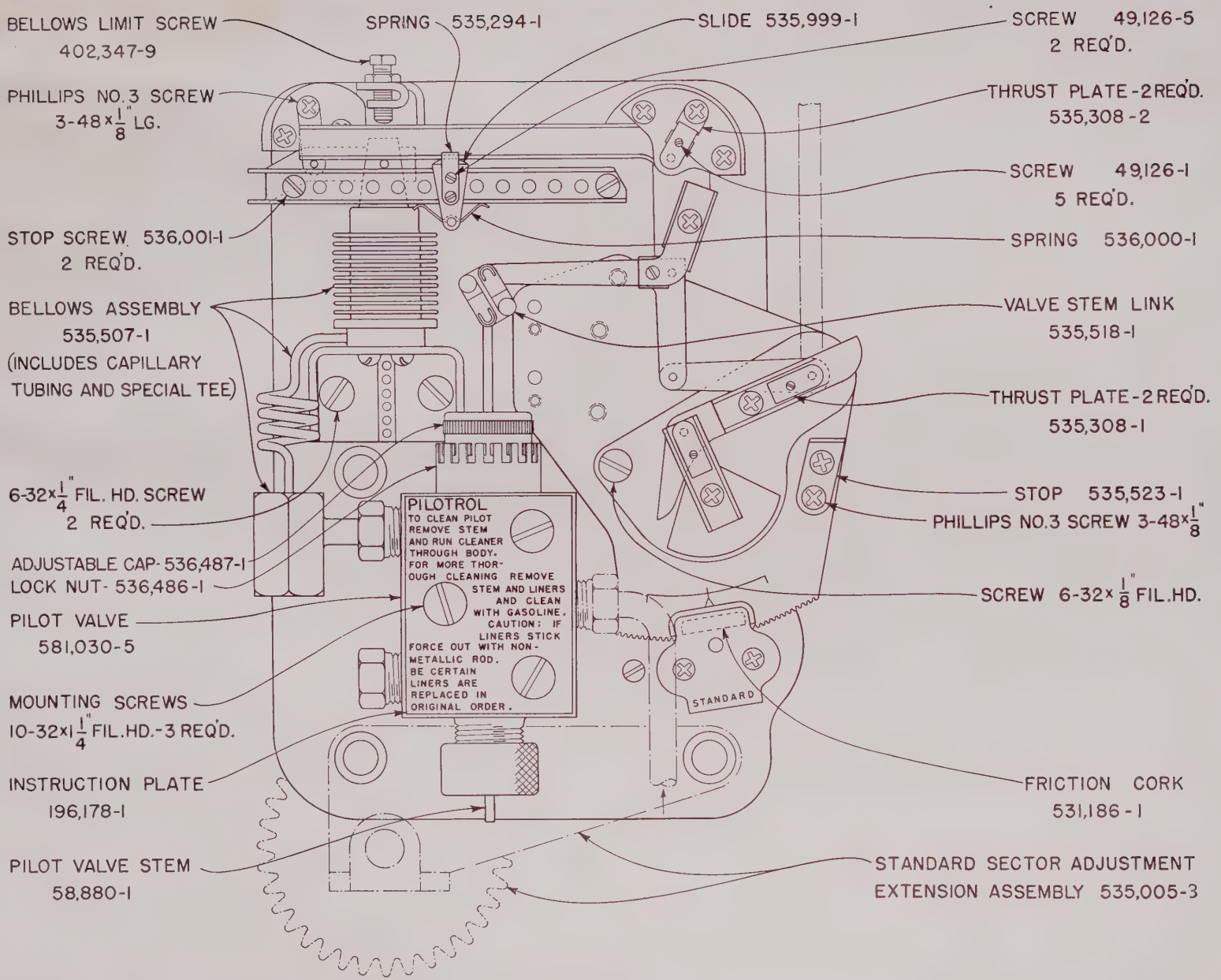


FIGURE 4

Pilotrol Parts List. Specify Serial Number When ordering Parts.

PILOTROL ASSEMBLY No. 535300-1

INSTRUCTIONS

SECTION AC 150-B

FOR CALIBRATION AND OPERATION OF

BAILEY RELAYS AND STANDATROLS

BAILEY METER COMPANY

CLEVELAND 10, OHIO

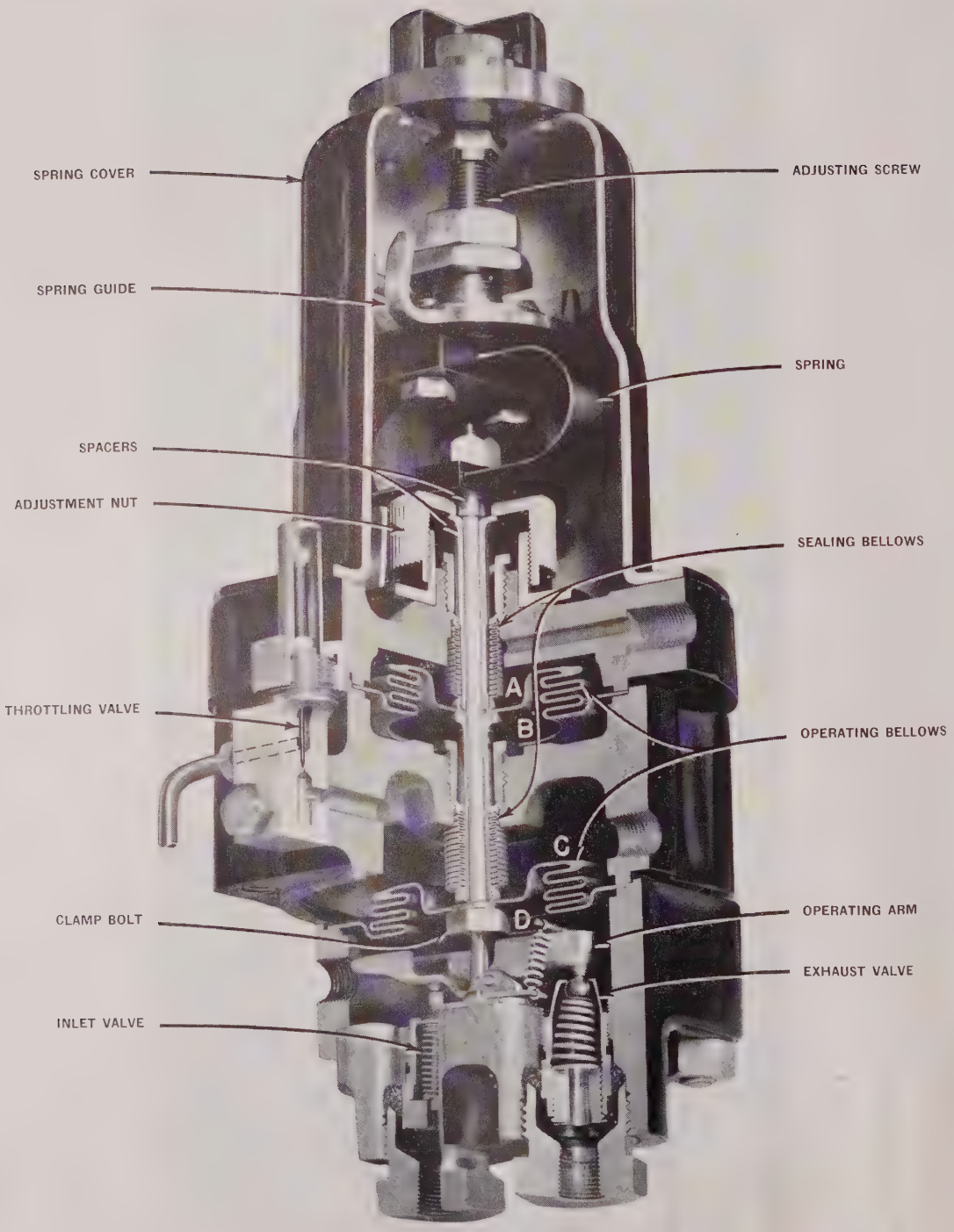


FIGURE 1
Standatrol or Relay Assembly

STANDATROLS AND RELAYS

The Bailey Air Relay may be used to amplify, add, subtract, or reverse loading pressure or pressures which are received from other control units, and to set up a modified loading pressure to operate a control system or integral units of a control system. One to three loading pressures may be admitted to the loading chambers of the relay.

ASSEMBLY

The assembly of a relay is shown by Fig. 1 to consist of four pressure chambers which are indicated as "A", "B", "C", and "D". Two equal area operating bellows separate "A" from "B" and "C" from "D" with a metal sealing bellows used between chambers "B" and "C". A second sealing bellows is used as a packing gland around the clamp bolt assembly where the bolt extends through the "A" chamber body. The operating bellows and sealing bellows are secured to the clamp bolt assembly so that the clamp bolt is free to move plus or minus $\frac{1}{32}''$. This travel is limited by the adjustment nut. A loop spring is attached to the upper end of the clamp bolt and the lower end positions an operating arm which operates the inlet and exhaust valves in chamber "D". An adjusting screw is attached to the upper section of the loop spring so that the spring loading on the clamp bolt assembly may be applied in either direction.

The assembly of all relays are identical except for the addition of a throttling valve on the standatrols and some types of relays.

PRINCIPLE OF OPERATION

The principle of operation is based on the admission or discharge of air from chamber "D" to balance the variations in air loading pressures which may be applied to chambers "A", "B", or "C". An air supply, normally 35 pounds pressure, is connected to the inlet valve, and air pressures of 5 to 25 pounds are normally used in one or more of the chambers "A", "B", and "C". If the air loading pressure is increased to chambers "A", or "C", the air pressures acting on the operating bellows will force the clamp bolt assembly down and open the inlet valve in chamber "D". Air pressure will be admitted to chamber "D" through the inlet valve until the force upward on the lower operating bellows is sufficient to balance the force on both operating bellows from the air pressures in chambers "A" and "C", thereby causing the clamp bolt to move upward until the inlet valve is closed.

If the air-loading pressure is decreased to chambers "A" or "C", the force of the chamber "D" air pressure on the lower operating bellows will move the clamp bolt upward and cause the exhaust valve to be opened, thereby decreasing the air pressure in chamber "D" and returning the exhaust valve to closed position. An increase in the air loading pressure to chamber "B" will have the same effect on the "D" chamber air pressure as a decrease in either chamber "A" or "C" air pressures. The forces within the relay are thus kept in equilibrium through the operation of the inlet and exhaust valves to admit or discharge air pressure as required. The air pressure in chamber "D" may be made to assume any value by varying the air loading pressures in chambers "A", "B" or "C".

The spring may exert a force up or down on the clamp bolt, the amount of the spring loading being dependent upon the application of the relay in the control system. The spring loading is normally used to balance a definite air pressure which may be applied to any one or more of the relay chambers. This balance establishes a normal control point for a given air loading pressure so that variations in air pressures from this control point will produce variations in the chamber "D" air pressure.

AVERAGING RELAY

PRINCIPLE OF OPERATION

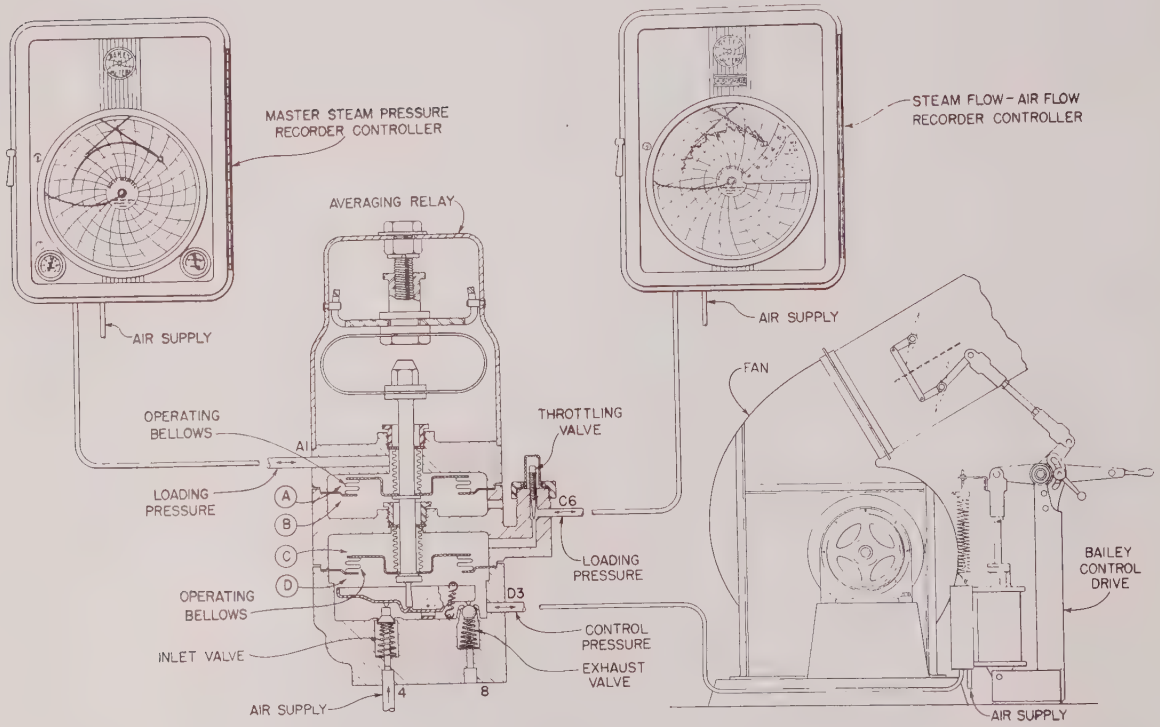


FIGURE 2

A typical relay application is shown by Figure 2 which is an operation diagram of the averaging relay. The air loading pressures from two separate controllers are combined in the relay to produce a control pressure which is used to operate the control drive and position the damper in the fan outlet duct. An air supply from the Master Steam Pressure Controller is admitted to chamber "A" through connection "A1", whereas the loading pressure from the Steam Flow - Air Flow Controller is admitted to chamber "C" through connection "C6" and a throttling valve. The throttling valve is used to introduce a delaying action between the Steam Flow-Air Flow Controller loading pressure change and the ultimate effect of this change on the pressure in chamber "C". This delaying action can be reduced or increased as desired by turning the throttling valve stem. The spring loading is normally set to balance 15 pounds pressure in chamber "C" so that the control pressure in chamber "D" will follow the air-loading pressure changes in chamber "A". However, should the relation between the Steam Flow-Air Flow vary so that the controller loading pressure is less or greater than 15 pounds, the loading pressure in chamber "C" will change to produce a like change in the air pressure in chamber "D". Therefore, the pressure in chamber "D" will vary from the pressure admitted to chamber "A" in the amount and direction that the "C" chamber pressure varies from 15 pounds.

The changes in the loading pressure from the Steam Flow-Air Flow Controller to chamber "C" due to the throttling valve action are therefore made secondary to the loading pressure changes from the Steam Pressure Controller which are immediately effective. This application of the relay illustrates how a control drive may be positioned by the loading pressure from one controller and readjusted in position from a second controller loading pressure.

STANDATROL

PRINCIPLE OF OPERATION

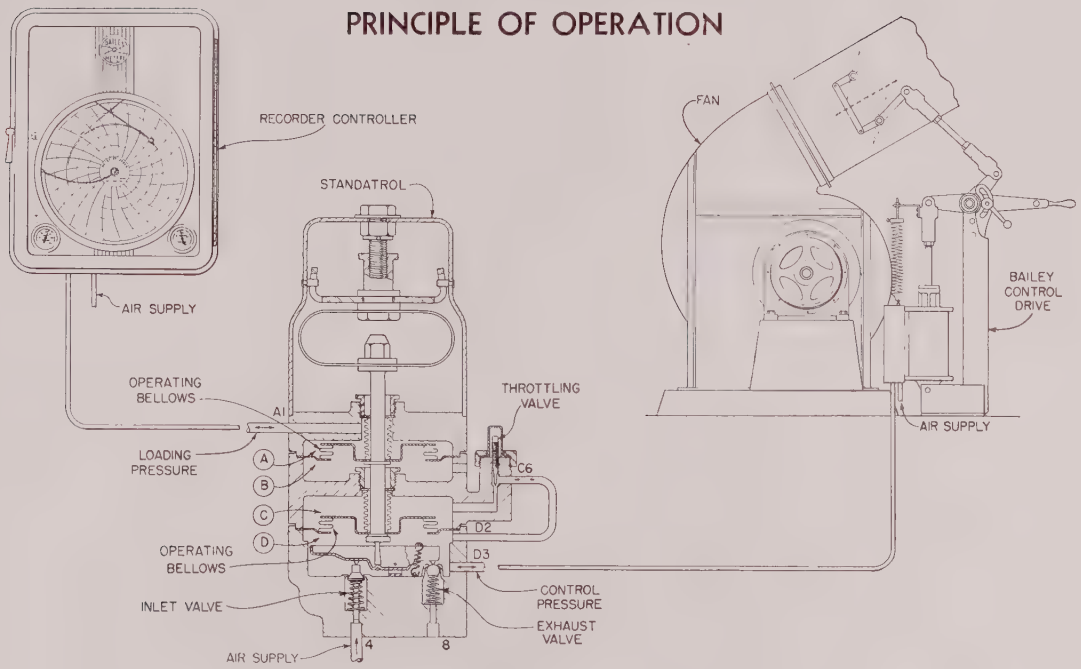


FIGURE 3

The function of the Standatrol Relay is to instantly reproduce the incoming loading pressure changes in the out-going control (or loading) pressure and, by means of a slow regenerative action, to amplify the change in outgoing air loading pressure until the incoming air loading pressure is returned a predetermined standard value.

A diagram of the Standatrol relay application in a typical control system is shown by Figure 3. The Master Controller air loading pressure is applied to chamber "A", through connection "A1". The air control pressure from chamber "D" is used to position the control drive which operates the fan outlet damper. A bypass connection between chambers "D" and "C" is provided with a throttling valve which may be adjusted to allow any desired rate of pressure interchange between the two chambers. The standard value for the incoming loading pressure is normally 15 pounds and is established by the spring adjustment.

If the controller loading pressure to chamber "A" decreases below the spring loading, the exhaust valve in chamber "D" will be opened to instantly decrease the pressure in chamber "D" an equal amount.

The pressure in chamber "D" will then be lower than that in chamber "C" by an amount equal to the decrease in pressure in chamber "A". Air will then flow through the throttling valve from chamber "C" to "D", thus reducing the pressure in chamber "C". The air exhaust valve in chamber "D" opens to maintain the differential between chambers "D" and "C" so that both pressures continue to decrease at the rate established by the opening of the throttling valve. A differential pressure between chambers "C" and "D" will continue to exist until the pressure in chamber "A" returns to the standard value.

When the pressure in chamber "A" returns to the standard value, the air pressure in chamber "D" will be equal to the pressure in chamber "C". No further pressure changes in chambers "C" and "D" will occur until the pressure in chamber "A" varies from the standard value.

A similar action in the opposite direction takes place on a pressure increase in chamber "A". Thus, by varying the controller air loading pressure above or below the standard value, the air pressure in chamber "D" may be made to assume any desired value between zero and the air supply pressure. Since a slight change in the controller loading pressure from the standard value is sufficient to change the control pressure over full range, the Standatrol can be used in the control system to maintain the controlled factor within close limits.

ACCELERATING RELAY

The accelerating relay may be used in the transmission of the controller air loading pressure to a control drive (or valve) for the purpose of immediately magnifying the air loading pressure changes, then demagnifying the pressure changes on a controlled time basis. The acceleration or magnification of the loading pressure changes are accomplished by applying the loading pressures to more than one chamber of the relay simultaneously, whereas the restoring action is accomplished by applying the loading pressure to a third chamber of the relay and introducing ahead of this third chamber a throttling valve to provide a delaying action between the acceleration and restoring action.

The two general types of accelerating relays are shown diagrammatically by Figures 4 and 5.

The spring adjustments for the accelerating relays are the same as those given on page 9 for the totalizing relay.

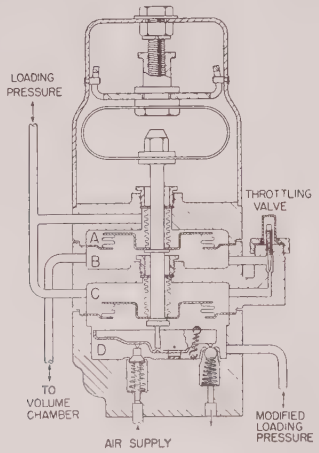


FIGURE 4

Figure 4 is a diagram of the accelerating relay which is used when a magnification of not more than two to one is required. The incoming loading pressure is applied to chambers A, B and C with a throttling valve introduced between chambers B and C. If the loading pressure changes are applied to chambers A, B and C simultaneously, then the pressure in chamber B would balance the pressure in chamber C so that changes in the loading pressure introduced into chamber A would be reproduced in the outgoing loading pressure in chamber D. However, upon introducing a throttling valve between chambers B and C so as to control the rate at which the pressure change in chamber B will equalize with the pressure in chamber C of the relay, then the outgoing loading pressure from chamber D can be made to follow the changes in the loading pressure in chamber A plus the change in the loading pressure in chamber C. When the pressure change occurs in chamber C, it will tend to equalize through the throttling valve with chamber B pressure and as these two pressures become equal, the magnification of the loading pressure change will be reduced to zero.

This relay therefore will produce twice the initial change in the outgoing loading pressure from chamber D that occurs in chambers A but immediately thereafter as the pressures between chambers B and C equalize, the change in the outgoing loading pressure in chamber D will become equal to the change which occurred in the loading pressure in chamber A.

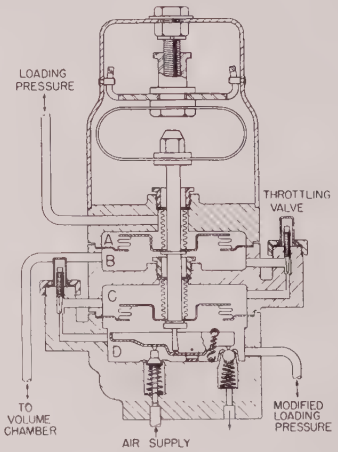


FIGURE 5

Figure 5 is a diagram of the accelerating relay which may be used to amplify the incoming loading pressure changes as much as 100 to 1. The incoming loading pressure is applied to chamber A of the relay and the outgoing or modified loading pressure is applied to chambers C and B, through throttling valves. If the two throttling valves are turned to the wide open position, then any change in the pressure in chamber D would be instantaneously reflected in chambers B and C so that no magnification of the change would be made. However, by adjusting the opening of the throttling valve between chambers D and C so that it has a faster rate of change than the throttling valve between chambers B and C, then a magnification of the pressure changes will be obtained. The amount of magnification is dependent upon the relative adjustment of these two throttling valves. When the loading pressure to the relay is changed in one direction, the outgoing loading pressure from the relay will continue to change in that same direction until the pressure change in chamber B is equal to the initial pressure change in chamber A. Thus, the magnification of the loading pressure change has reached the maximum value and as the pressures in chambers B and C continue to equalize, demagnification of the loading pressure change occurs.

Standatrol and Relay Assembly with Adjustments

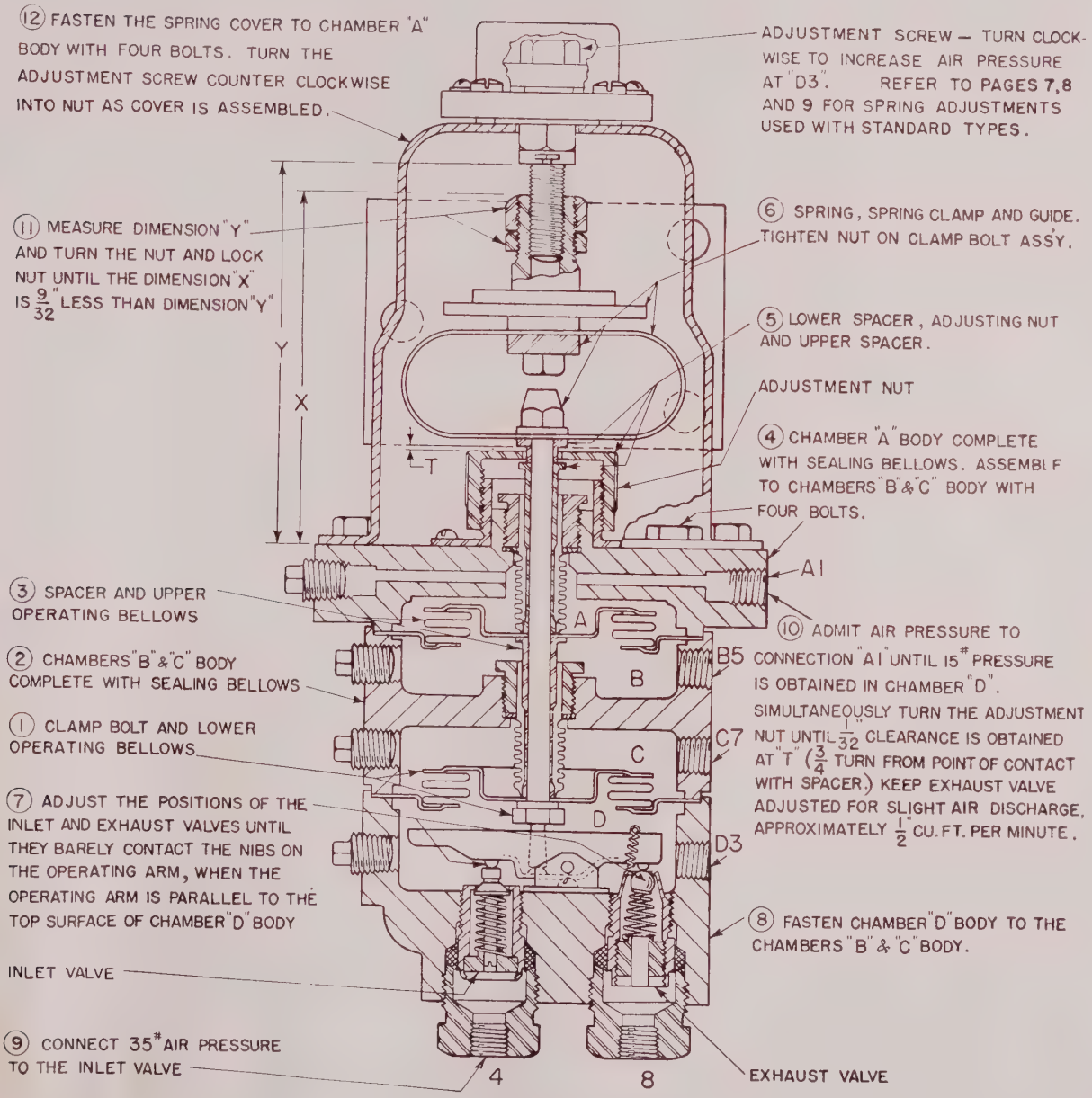

(12) FASTEN THE SPRING COVER TO CHAMBER "A" BODY WITH FOUR BOLTS. TURN THE ADJUSTMENT SCREW COUNTER CLOCKWISE INTO NUT AS COVER IS ASSEMBLED.
ADJUSTMENT SCREW — TURN CLOCKWISE TO INCREASE AIR PRESSURE AT "D3". REFER TO PAGES 7,8 AND 9 FOR SPRING ADJUSTMENTS USED WITH STANDARD TYPES.
(11) MEASURE DIMENSION "Y" AND TURN THE NUT AND LOCK NUT UNTIL THE DIMENSION "X" IS 9/32" LESS THAN DIMENSION "Y"
Y
X
T
(6) SPRING, SPRING CLAMP AND GUIDE. TIGHTEN NUT ON CLAMP BOLT ASS'Y.
(5) LOWER SPACER, ADJUSTING NUT AND UPPER SPACER.
ADJUSTMENT NUT
(4) CHAMBER "A" BODY COMPLETE WITH SEALING BELLOWS. ASSEMBLE TO CHAMBERS "B" & "C" BODY WITH FOUR BOLTS.
A1
(3) SPACER AND UPPER OPERATING BELLOWS
(2) CHAMBERS "B" & "C" BODY COMPLETE WITH SEALING BELLOWS
(1) CLAMP BOLT AND LOWER OPERATING BELLOWS
(7) ADJUST THE POSITIONS OF THE INLET AND EXHAUST VALVES UNTIL THEY BARELY CONTACT THE NIBS ON THE OPERATING ARM, WHEN THE OPERATING ARM IS PARALLEL TO THE TOP SURFACE OF CHAMBER "D" BODY
A
B
C
D
B5
C7
D3
(10) ADMIT AIR PRESSURE TO CONNECTION "A1" UNTIL 15# PRESSURE IS OBTAINED IN CHAMBER "D". SIMULTANEOUSLY TURN THE ADJUSTMENT NUT UNTIL 1/32" CLEARANCE IS OBTAINED AT "T" (3/4 TURN FROM POINT OF CONTACT WITH SPACER.) KEEP EXHAUST VALVE ADJUSTED FOR SLIGHT AIR DISCHARGE, APPROXIMATELY 1/2" CU. FT. PER MINUTE.
(8) FASTEN CHAMBER "D" BODY TO THE CHAMBERS "B" & "C" BODY.
INLET VALVE
(9) CONNECT 35# AIR PRESSURE TO THE INLET VALVE
4
8
EXHAUST VALVE

FIGURE 6

The assembly and adjustment of the relays is shown in Figure 6. The numerical order as indicated should be followed in the assembly of the relay and to complete the adjustments. If it is desired to dis-assemble the relay, the numerical order would be from 12 to 1.

The throttling valve, which is included on the Standatrols and some types of relays, is adjusted by removing the cover and turning the valve stem. Turning the valve stem clockwise will increase the throttling action and decrease the rate of air pressure interchange between chambers "C" and "D".

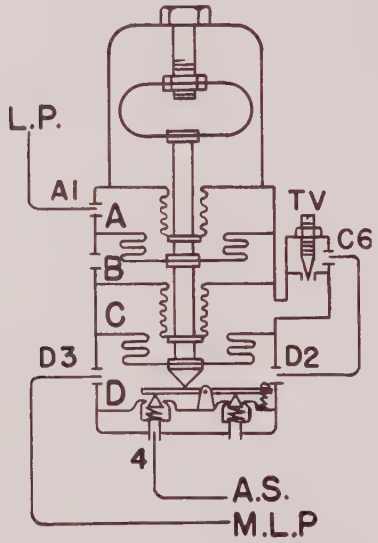
SPRING ADJUSTMENTS

FOR STANDARD TYPES OF RELAYS AND STANDATROLS

The Relays and Standatrols which are normally used with standard spring adjustments are shown on pages 8, 9 and 10. The air loading pressure is applied to chambers "A", "B" or "C" as indicated and the adjustment screw turned until the correct modified loading pressure is obtained at connection "D3 (connection "C7" on floating type Standatrol). The relays or Standatrols with standard calibrations are stamped with the numbers one to nine on the flange just above the throttling valve position. This number corresponds to the last digit in the part number of the relay or Standatrol as shown on pages 8, 9 and 10. Relays or Standatrols which are stamped with the numeral 10 have special spring adjustments and when used, a special spring adjustment data sheet will be attached to this instruction.

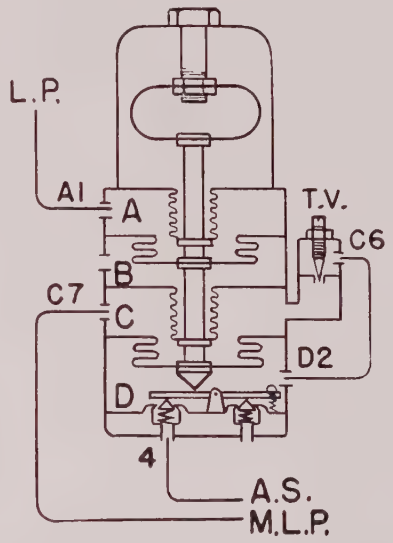
ABBREVIATIONS

A.S. = Air Supply
L.P. = Loading Pressure
T.V. = Throttling Valve
M.L.P. = Modified Load-Pressure (or Control Pressure)



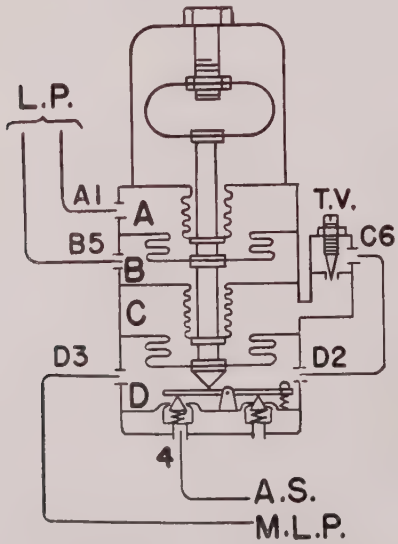
STANDATROL (POSITIONING TYPE)
Part No. 535,608-1

Adjust spring loading for 15 lbs. air pressure at connection D3 (throttling valve in full open position) with 15 lbs. air loading pressure applied at connection A1. Adjust throttling valve to give desired rate of change in modified loading pressure. Normal air supply pressure 35 lbs.



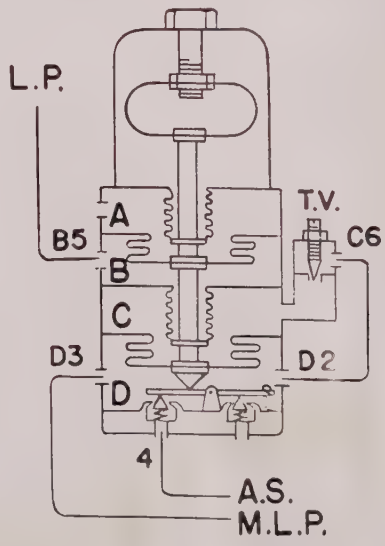
STANDATROL (FLOATING TYPE)
Part No. 535,608-1

Adjust spring loading for 15 lbs. air pressure at connection C7 (throttling valve in full open position) with 15 lbs. air loading pressure applied at connection A1. Adjust throttling valve to give desired rate of change in modified loading pressure. Normal air supply pressure 35 lbs.



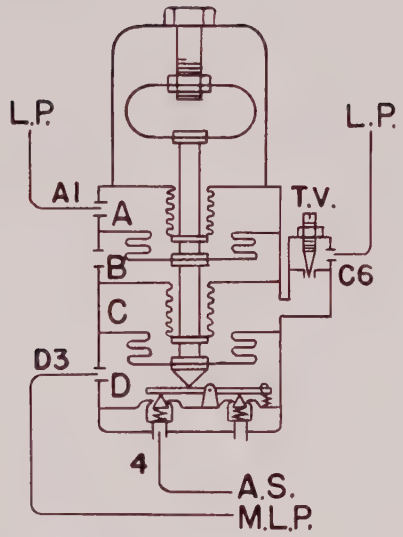
DIFFERENTIAL STANDATROL
Part No. 535,608-2

Adjust spring loading for 15 lbs. air pressure at connection D3 (throttling valve in full open position) with 15 lbs. air loading pressures applied at connections A1 and B5. Adjust throttling valve to give desired rate of change in modified loading pressure. Normal air supply pressure 35 lbs.



REVERSING STANDATROL
Part No. 535,608-3

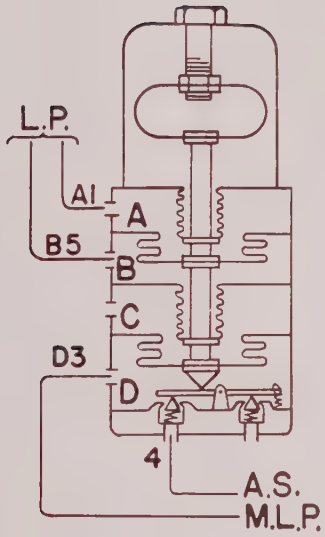
Adjust spring loading for 15 lbs. air pressure at connection D3 (throttling valve in full open position) with 15 lbs. air loading pressure applied at connection B5. Adjust throttling valve to give desired rate of change in modified loading pressure. Normal air supply pressure 35 lbs.



AVERAGING RELAY

Part No. 535,608-4

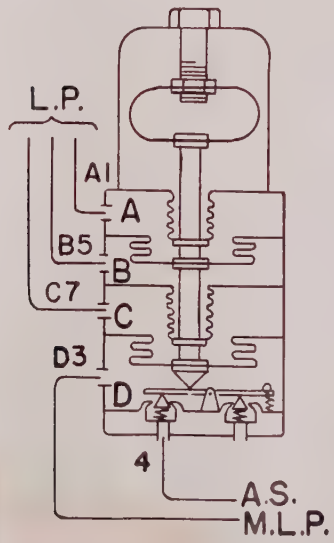
Adjust spring loading for 15 lbs. air pressure at connection D3 with 15 lbs. air loading pressures applied at connections A1 and C6. (Throttling valve in full open position). Adjust throttling valve to give desired rate of change in D3 air pressure when L. P. to C6 changes. Normal air supply pressure 35 lbs.



DIFFERENTIAL RELAY

Part No. 535,608-5

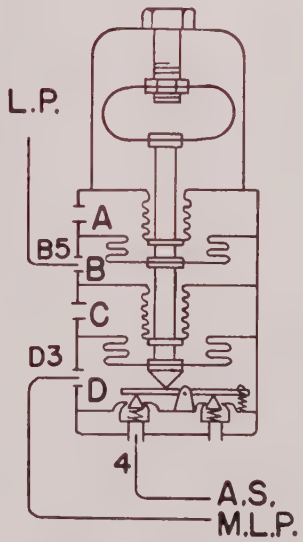
Adjust spring loading for 15 lbs. air pressure at connection D3 with 15 lbs. air loading pressures applied at connections A1 and B5. Normal air supply pressure 35 lbs.



TOTALIZING RELAY

Part No. 535,608-6

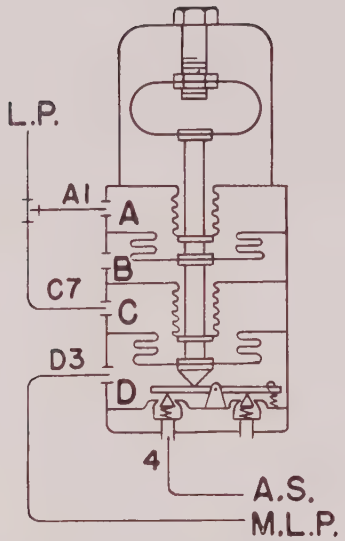
Adjust spring loading for 15 lbs. air pressure at connection D3 with 15 lbs. air loading pressure applied at connections A1, B5 and C7. Normal air supply pressure 35 lbs.



REVERSING RELAY

Part No. 535,608-7

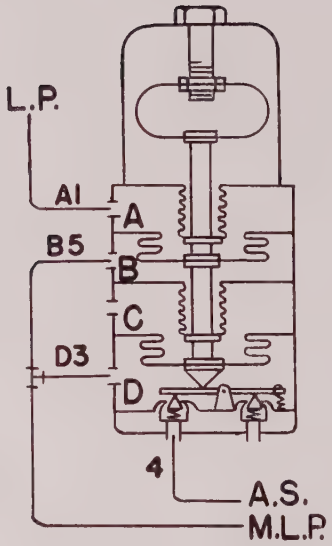
Adjust spring loading for 15 lbs. air pressure at connection D3 with 15 lbs. air loading pressure applied at connection B5. Normal air supply pressure 35 lbs.



DOUBLING RELAY

Part No. 535,608-8

Adjust spring loading for 25 lbs. air pressure at connection D3 with 15 lbs. air loading pressure applied at connections A1 and C7. Normal air supply pressure 35 lbs.



HALVING RELAY

Part No. 535,608-9

Adjust spring loading for 15 lbs. air pressure at connections D3 and B5 with 25 lbs. air loading pressure applied at connection A1. Normal air supply pressure 35 lbs.

MAINTENANCE

The inlet and exhaust vales on the relay of the standatrol should be the first parts inspected when the unit is not operating correctly. The faulty operation is frequently caused by metal chips from the connecting piping, lodging between the cone and seat of the inlet valve. The obstruction in the inlet valve can generally be eliminated by removing the exhaust valve so that a pencil or screw driver may be inserted through the exhaust valve opening for moving the operation arm. The rush of air through the inlet valve when moving the operation arm to permit an alternate open and shut position of the inlet valve, will generally remove the obstruction. Inspect the exhaust valve for any obstruction before it is replaced. *Do not remove or adjust the position of the inlet valve during the operation described above.*

If it is necessary to clean both the inlet and exhaust valves, the chamber "D" section should be removed from the relay assembly. Observe the position of the operating arm when the nibs are barely contacting the inlet and exhaust valves before removing either valve. Remove, clean and replace one valve at a time in order that the valves can be returned to the same relative position with the operating arm. The position of the operating arm should be the same as described by operation 7, Figure 6.

The adjustment of the relay or Standatrol should be checked after reassembly of the "D" chamber, by applying air loading pressures to the chambers as indicated on pages 8, 9 and 10, or by the attached data sheet if the relay or Standatrol has a special calibration. Should any difficulty be experienced with this final adjustment, recheck adjustments 7 and 10 as described by Figure 6.

It is essential that the assembly have no leakage between chambers as this would affect [illegible] operation of the relay. A leakage test [illegible] pplying an air pressure to any one chamber, with the adjacent chamber opened to atmosphere, and noting if there is any air discharged. If leakage is detected, the relay should be taken apart and the bellows inspected for any fracture. Replace any defective parts and reassemble the relay with cement on all contact surfaces as indicated by Figure 7.

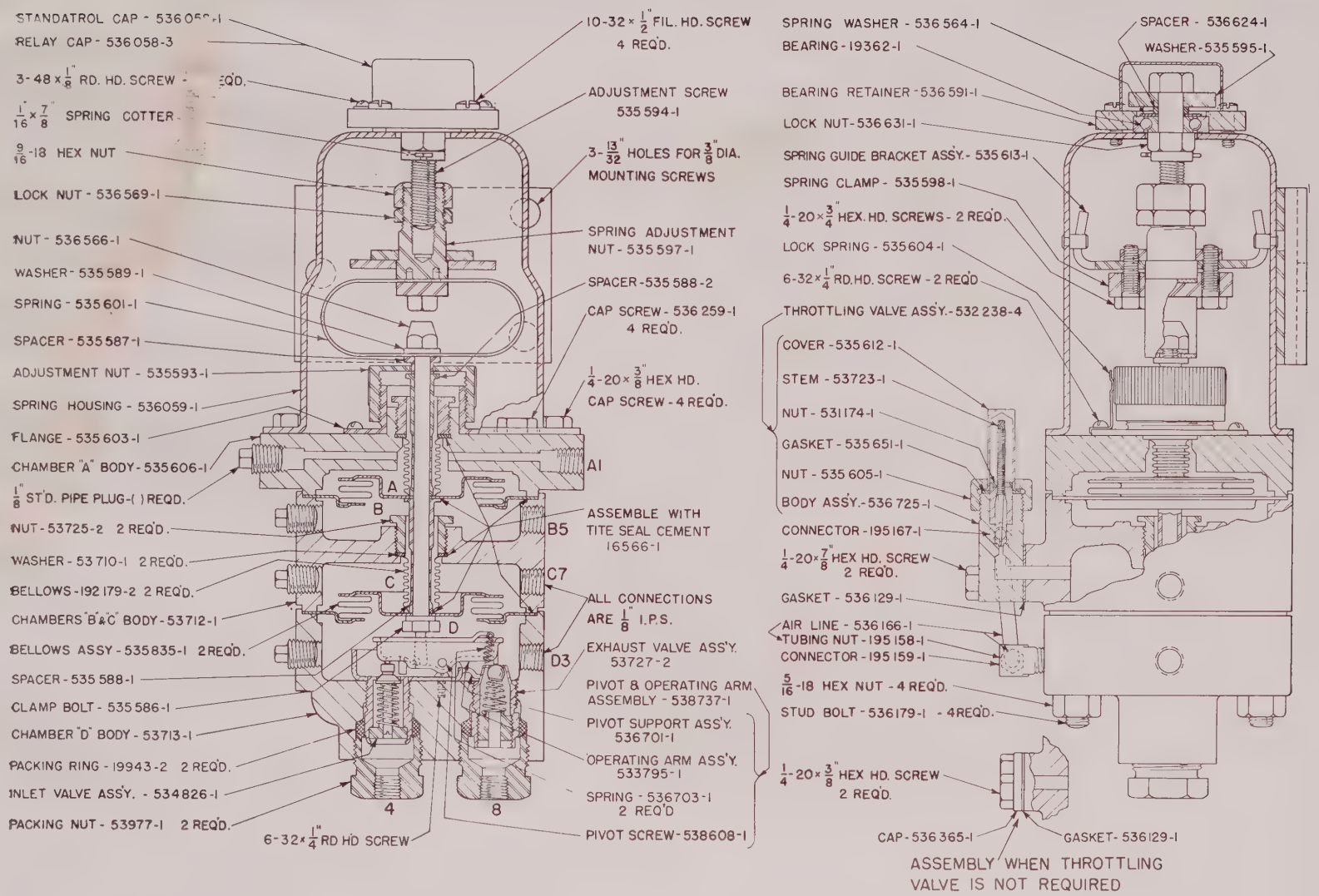
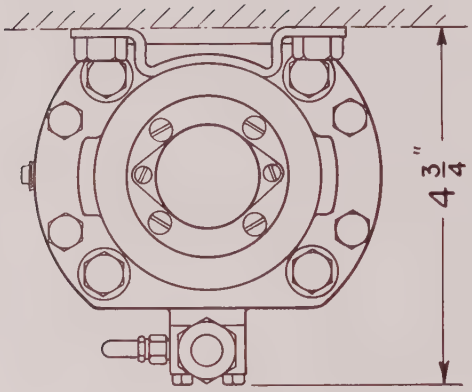

STANDATROL CAP - 536058-1
RELAY CAP - 536058-3
3-48 x 1/8" RD. HD. SCREW - EQD.
1/16" x 7/8" SPRING COTTER
9/16-18 HEX NUT
LOCK NUT - 536569-1
NUT - 536566-1
WASHER - 535589-1
SPRING - 535601-1
SPACER - 535587-1
ADJUSTMENT NUT - 535593-1
SPRING HOUSING - 536059-1
FLANGE - 535603-1
CHAMBER "A" BODY - 535606-1
1/8" ST'D. PIPE PLUG-( ) REQD.
NUT - 53725-2 2 REQ'D.
WASHER - 53710-1 2 REQ'D.
BELLOWS - 192179-2 2 REQ'D.
CHAMBERS "B" & "C" BODY - 53712-1
BELLOWS ASSY - 535835-1 2 REQ'D.
SPACER - 535588-1
CLAMP BOLT - 535586-1
CHAMBER "D" BODY - 53713-1
PACKING RING - 19943-2 2 REQ'D.
INLET VALVE ASS'Y. - 534826-1
PACKING NUT - 53977-1 2 REQ'D.
6-32 x 1/4" RD HD SCREW
10-32 x 1/2" FIL. HD. SCREW 4 REQ'D.
ADJUSTMENT SCREW 535594-1
3-13/32" HOLES FOR 3/8" DIA. MOUNTING SCREWS
SPRING ADJUSTMENT NUT - 535597-1
SPACER - 535588-2
CAP SCREW - 536259-1 4 REQ'D.
1/4-20 x 3/8" HEX HD. CAP SCREW - 4 REQ'D.
A1
ASSEMBLE WITH TITE SEAL CEMENT 16566-1
B5
C7
ALL CONNECTIONS ARE 1/8" I.P.S.
EXHAUST VALVE ASS'Y. 53727-2
D3
PIVOT & OPERATING ARM ASSEMBLY - 538737-1
PIVOT SUPPORT ASS'Y. 536701-1
OPERATING ARM ASS'Y. 533795-1
SPRING - 536703-1 2 REQ'D
PIVOT SCREW - 538608-1
A
B
C
D
4
8
SPRING WASHER - 536564-1
BEARING - 19362-1
BEARING RETAINER - 536591-1
LOCK NUT - 536631-1
SPRING GUIDE BRACKET ASS'Y. - 535613-1
SPRING CLAMP - 535598-1
1/4-20 x 3/4" HEX. HD. SCREWS - 2 REQ'D.
LOCK SPRING - 535604-1
6-32 x 1/4" RD. HD. SCREW - 2 REQ'D
THROTTLING VALVE ASS'Y. - 532238-4
COVER - 535612-1
STEM - 53723-1
NUT - 531174-1
GASKET - 535651-1
NUT - 535605-1
BODY ASS'Y. - 536725-1
CONNECTOR - 195167-1
1/4-20 x 7/8" HEX HD. SCREW 2 REQ'D.
GASKET - 536129-1
AIR LINE - 536166-1
TUBING NUT - 195158-1
CONNECTOR - 195159-1
5/16-18 HEX NUT - 4 REQ'D.
STUD BOLT - 536179-1 - 4 REQ'D.
1/4-20 x 3/8" HEX HD. SCREW 2 REQ'D.
CAP - 536365-1
GASKET - 536129-1
SPACER - 536624-1
WASHER - 535595-1
ASSEMBLY WHEN THROTTLING VALVE IS NOT REQUIRED

FIGURE 7
Standatrol or Relay

MOUNTING DIMENSIONS

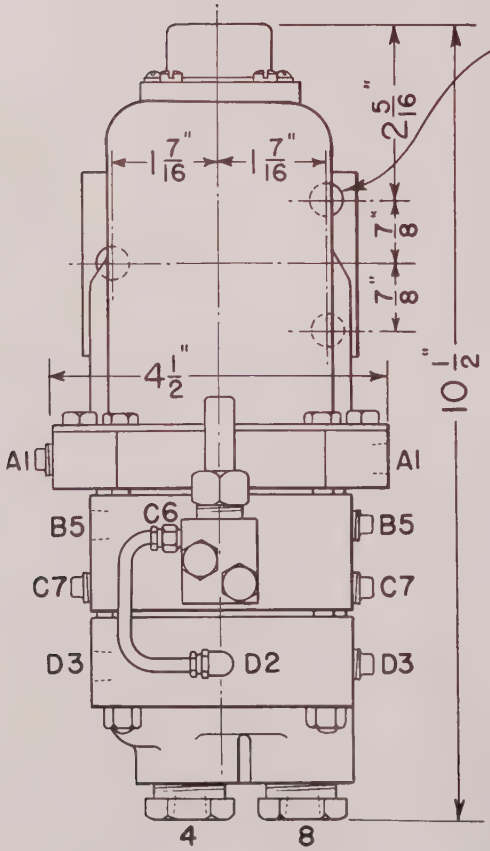
FOR RELAYS AND STANDATROLS

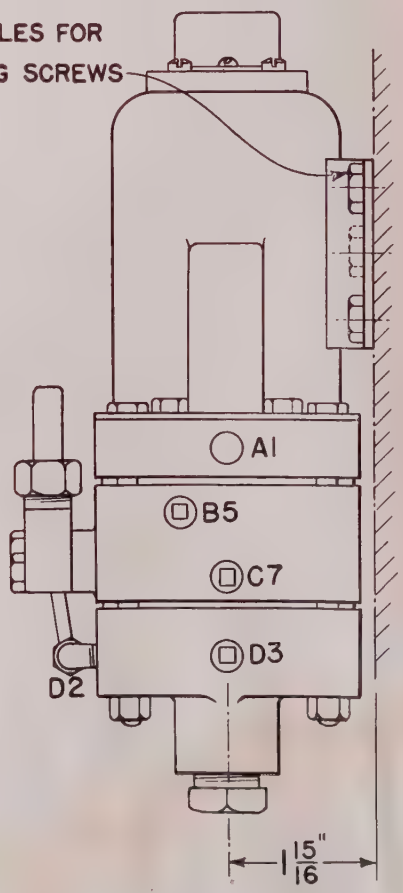


NOTES:-

ALL AIR LINE CONNECTIONS ARE 1/8" PIPE TAP.

UNIT MAY BE MOUNTED IN ANY POSITION.





PART NO. 535608-( )

FIGURE 8

4500 PRINTED IN U. S. A. 4-45

INSTRUCTIONS

SECTION AC 200-A

FOR ADJUSTMENT AND OPERATION OF

BAILEY SELECTOR VALVES
AND REMOTE MANUAL RELAY

BAILEY METER COMPANY

CLEVELAND 10, OHIO

SELECTOR VALVE

The Bailey Selector Valve is used in the control system so that a choice is provided for either "Hand" or "Automatic" operation of the control system or units of the control system. The Selector Valve is normally installed on a conveniently located control panel.

The air pressure, which is indicated by the control pressure gage on the selector valve, is used to position the control drive (or valve) and the gage serves as a visual indication of the control drive (or valve) position, during either "automatic" or "hand" operation.

The Remote Manual Relay as shown by Figure 6 is used for hand operated control systems. The air control pressures which are used to position the control drive (or valve) are established by turning the load adjusting knob.

The mounting dimensions for both the selector valve and remote manual relay are shown by Figure 8

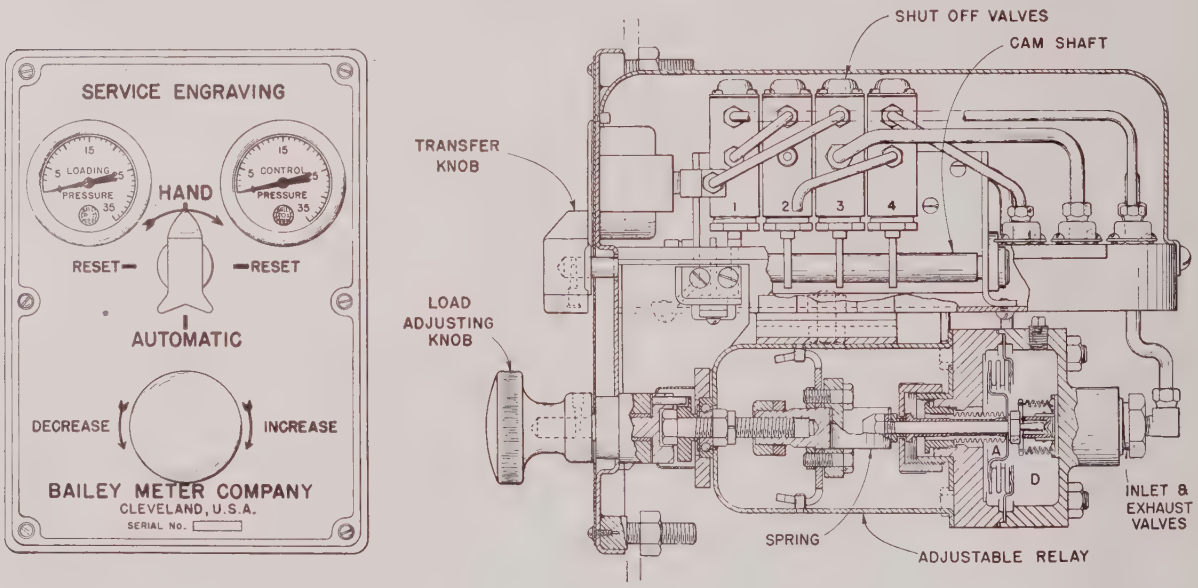


FIGURE 1

ASSEMBLY AND OPERATION

The Selector Valve is illustrated by Figure 1. It consists of an adjustable relay, a series of cam operated shut-off valves and air pressure gages to indicate the loading and control air pressures. The transfer knob, which is attached to the cam shaft, is used to operate the shut-off valves and to select either "hand" or "automatic" control of the control drive (or valve). The transfer knob has four positions, which are "hand", "reset", "automatic" and "reset". The "reset" positions are used to adjust the air or spring loading in the adjustable relay when a transfer from either hand or automatic operation is being made.

The adjustable relay reproduces the loading pressure which is received from another control unit such as a Standatrol, relay or controller when the transfer knob is in the automatic position, or converts the adjustable spring loading into an air control pressure when the transfer knob is in the hand position. The reproduced air pressure in chamber "D" is indicated by the control pressure gage and is the air control pressure which is used to position the control drive (or valve). The air loading pressure which is received from another control unit is shown by the air loading pressure gage.

The adjustable relay assembly as shown by Figures 1 and 7 includes a loading chamber "A", a relay chamber "D" with inlet and exhaust valves and an adjustable loading spring. The load adjusting knob is turned to apply a tension, compression or

zero spring loading on the bellows which separates chambers "A" and "D". Changes in the spring loading will operate the inlet or exhaust valves and increase or decrease the air pressure in chamber "D" which will react on the bellows to balance the spring loading. The admission of a loading pressure to chamber "A" will operate the inlet or exhaust valves and reproduce an air pressure in chamber "D" which will have the same value as chamber "A" loading pressure, when the spring loading is zero.

The control system is normally arranged for an increase in control pressure to open a damper, valve or other control units. However, in some special arrangements the control pressure may decrease to open a damper, valve or other control units.

The normal control pressure range is 5 to 25 pounds when using 28 pounds air supply pressure. The 5 and 25 pound control pressures correspond to the control drive (or valve) minimum and maximum travel. Intermediate air control pressure between 5 and 25 pounds indicate proportionate control drive (or valve) positions between minimum and maximum travel.

Diagrammatic arrangements of the selector valve application and remote manual relay are shown by Figures 2, 3, 4, 5, and 6.

HAND OPERATION

When the transfer knob is turned to the "hand" position, the relay load adjusting knob must be used to adjust the control pressure. The load adjusting knob is turned clockwise to increase the flow of air, gas, oil, steam, etc., regardless of whether the control air pressure increases or decreases.

To Transfer from Hand to Automatic Operation

(1) Turn the relay load adjusting knob very slowly until the control pressure is equal to the loading pressure. Observe the final value of the control pressure.

(2) Turn the transfer knob to reset position.

(3) Rotate the relay load adjusting knob until the control pressure is the same as observed in operation 1. (Do not leave the transfer knob in reset position longer than is necessary to adjust the control pressure).

(4) Turn the transfer knob to automatic position.

(5) If any difference exists between the loading pressure and the control pressure, the pressures should be equalized by slowly turning the relay load adjusting knob.

AUTOMATIC OPERATION

When the transfer knob is in the "automatic" position, the loading pressure is normally received from a controller, Standatrol or relay and is reproduced in the adjustable relay so that the control pressure is always equal to the loading pressure. However, the relative value of the control pressure to the loading pressure may be increased or decreased by turning the load adjusting knob, which will apply a spring loading bias.

To Transfer from Automatic to Hand Operation

(1) Observe the value of the control pressure.

(2) Turn the transfer knob to reset position.

(3) Rotate the relay load adjusting knob until the control pressure is the same as observed in operation 1. (Do not leave the transfer knob in reset position longer than is necessary to adjust the control pressure.)

(4) Turn the transfer knob to hand position. (Changes in control pressure are made by turning the load adjusting knob.)

OPERATION DIAGRAMS

OPERATION DIAGRAM FOR TYPE A62 SELECTOR VALVE

A diagrammatic arrangement of the Type A62 Selector Valve is shown by Figure 2. The transfer knob is shown in the "automatic" position with shut-off valves 1 and 3 open and 2 closed. The controller loading pressure is admitted through shut-off valve 1, to chamber "A" of the adjustable relay, which causes a similar air pressure to be reproduced in chamber "D". The pressure in chamber "D", which is the contro pressure, is transmitted to the control valve or drive through shut-off valve 3.

When the transfer knob is in the "hand" position, shut-off valves 2 and 3 are open and 1 is closed. Since chamber "A" is vented to atmosphere through shut-off valve 2, the control pressure in chamber "D" is determined by the spring loading. The control pressure may be adjusted to any desired value by turning the relay load adjusting knob.

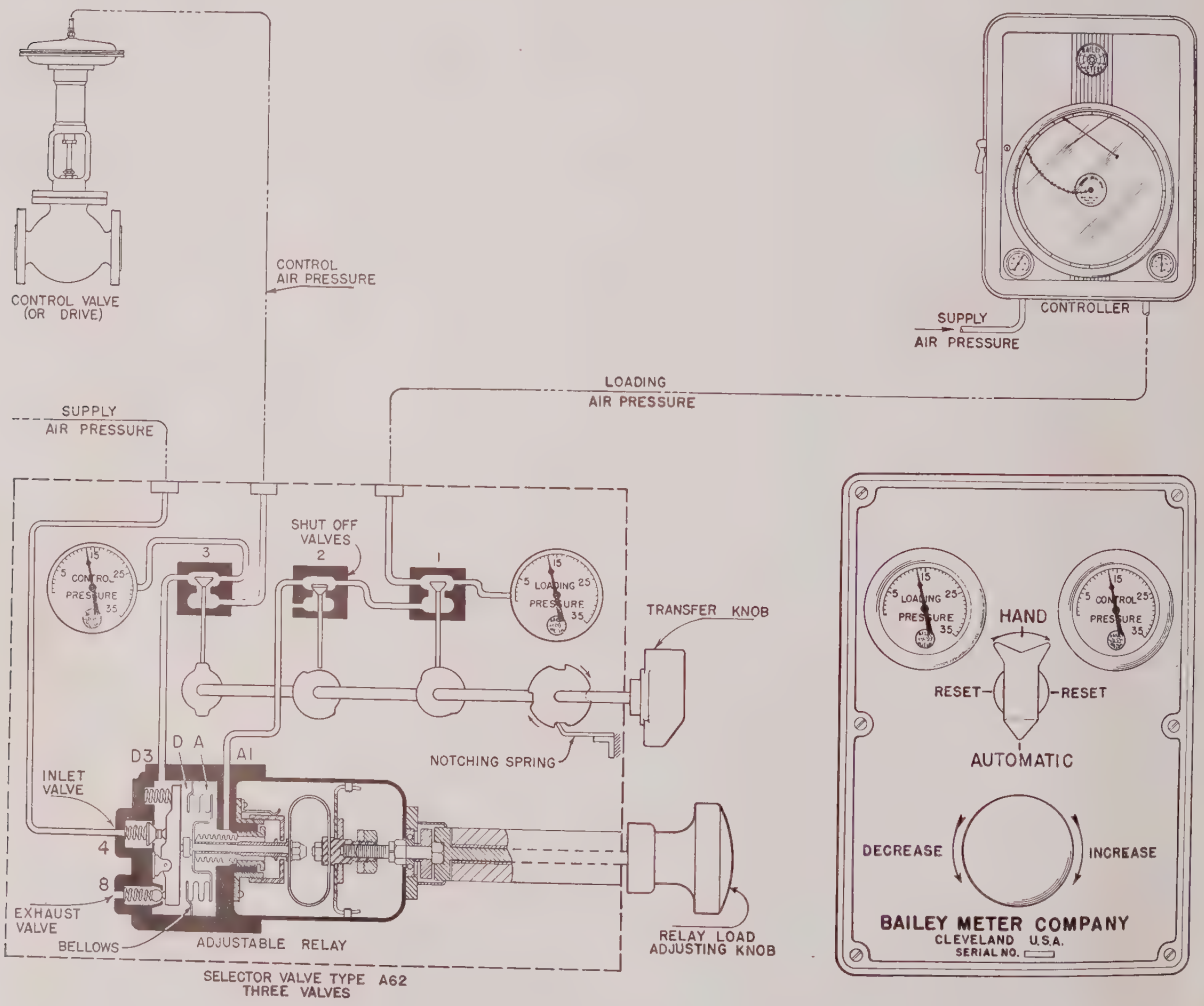


FIGURE 2

TRANSFER KNOB POSITION	SHUTOFF VALVE POSITION			SELECTOR VALVE OPERATION
	No. 1	No. 2	No. 3**	
Hand	Closed	Open	Open	The control air pressure is increased or decreased by turning the relay load adjusting knob.
Reset*	Open	Closed	Closed	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from the "hand" position.
Automatic	Open	Closed	Open	The loading air pressure changes are reproduced in the control air pressure. However, the load adjusting knob may be turned to increase or decrease the relative value of control to loading pressure.
Reset*	Closed	Open	Closed	Turn the load adjusting knob until the control air Pressure is equal to the observed control air pressure, prior to the transfer from "automatic" position.

* Do not leave the transfer knob in reset position.

**No. 3 Shutoff valve operates before other valves.

OPERATION DIAGRAM FOR TYPE A62-4 SELECTOR VALVE

When the Loading Pressure is Received from the Standatrol Connection D3.

A diagrammatic arrangement of the Type A62-4 Selector Valve is shown by Figure 3 for a standardizing control system. The loading pressure is received from the Standatrol relay chamber "D", which provides the standardizing action.

The transfer knob is shown in the "automatic" position with shut-off valves 1 and 3 open and 2 and 4 closed. The controller loading pressure is admitted to chamber "A" of the Standatrol relay. A modified loading pressure from chamber "D" of the Standatrol relay is admitted through shut-off valve 1 to chamber "A" of the selector valve adjustable relay, where the loading pressure is reproduced in chamber "D". The air pressure in the adjustable relay chamber "D" is transmitted through shut-off valve 3 to the control valve (or drive).

When the transfer knob is in the "hand" position, valves 2, 3 and 4 are open and 1 is closed. Since chamber "A" is vented to atmosphere through shut-off valve 2, the control pressure produced in the adjustable relay, chamber "D", is determined by the amount of spring loading. The pressure in chamber "C" of the Standatrol is maintained at the same value as the control pressure during hand operation so that transfer to automatic control can be made without delay when desired.

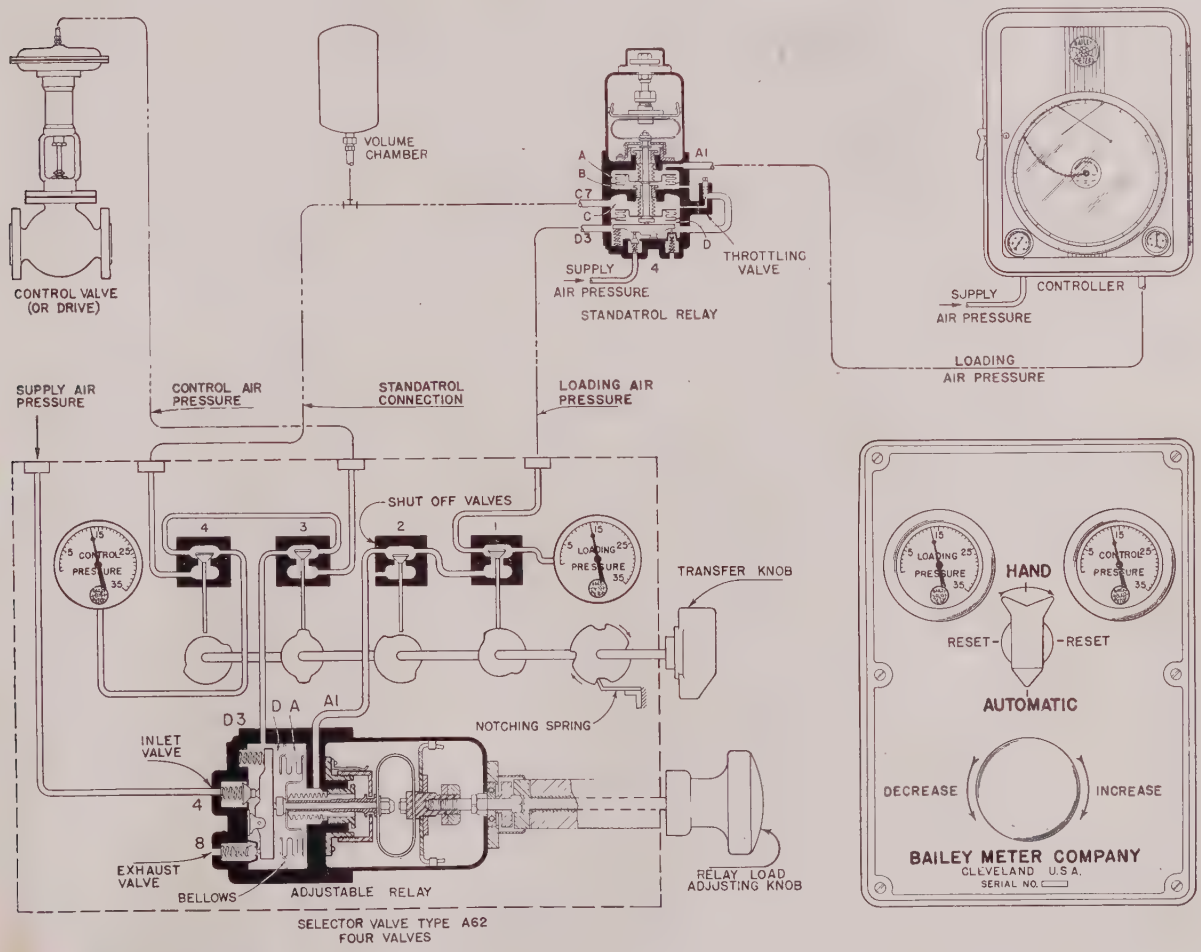


FIGURE 3 . . . Diagram of Selector Valve Operation Loading from Standatrol Chamber "D"

TRANSFER KNOB POSITION	SHUTOFF VALVE POSITION				SELECTOR VALVE OPERATION
	No. 1	No. 2	No. 3**	No. 4	
Hand	Closed	Open	Open	Open	The control air pressure is increased or decreased by turning the relay load adjusting knob.
Reset*	Open	Closed	Closed	Open	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from the "hand" position.
Automatic	Open	Closed	Open	Closed	The loading air pressure changes are reproduced in the control air pressure. However, the load adjusting knob may be turned to increase or decrease the relative value of control to loading pressure.
Reset*	Closed	Open	Closed	Closed	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from "automatic" position.

* Do not leave the transfer knob in reset position.

**No. 3 Shutoff valve operates before other valves.

OPERATION DIAGRAM FOR TYPE A62-4 SELECTOR VALVE

When the Loading Pressure is Received from the Standatrol Connection C7.

A diagrammatic arrangement of the Type A62-4 selector valve is shown by Figure 4 for a floating control system.

The transfer knob is shown in the "automatic" position with shut-off valves 1 and 3 open, 2 and 4 closed. The controller loading pressure is admitted to chamber "A" of the Standatrol relay and a modified loading pressure from chamber "C" of the Standatrol is admitted through shut-off valve 1 to chamber "A" of the adjustable relay where it is reproduced in chamber "D". The air pressure in the adjustable relay chamber "D" is transmitted through the shut-off valve 3 to the control valve or (drive.)

When the transfer knob is in the "hand" position, shut-off valves 2, 3 and 4 are open and 1 is closed. Since chamber "A" is vented to atmosphere through shut-off valve 2, the control pressure in the adjustable relay chamber "D" is determined by the spring loading.

The pressure in chamber "C" of the Standatrol is maintained at the same value as the control pressure during "hand" operation so that transfer to automatic position can be made without delay when desired.

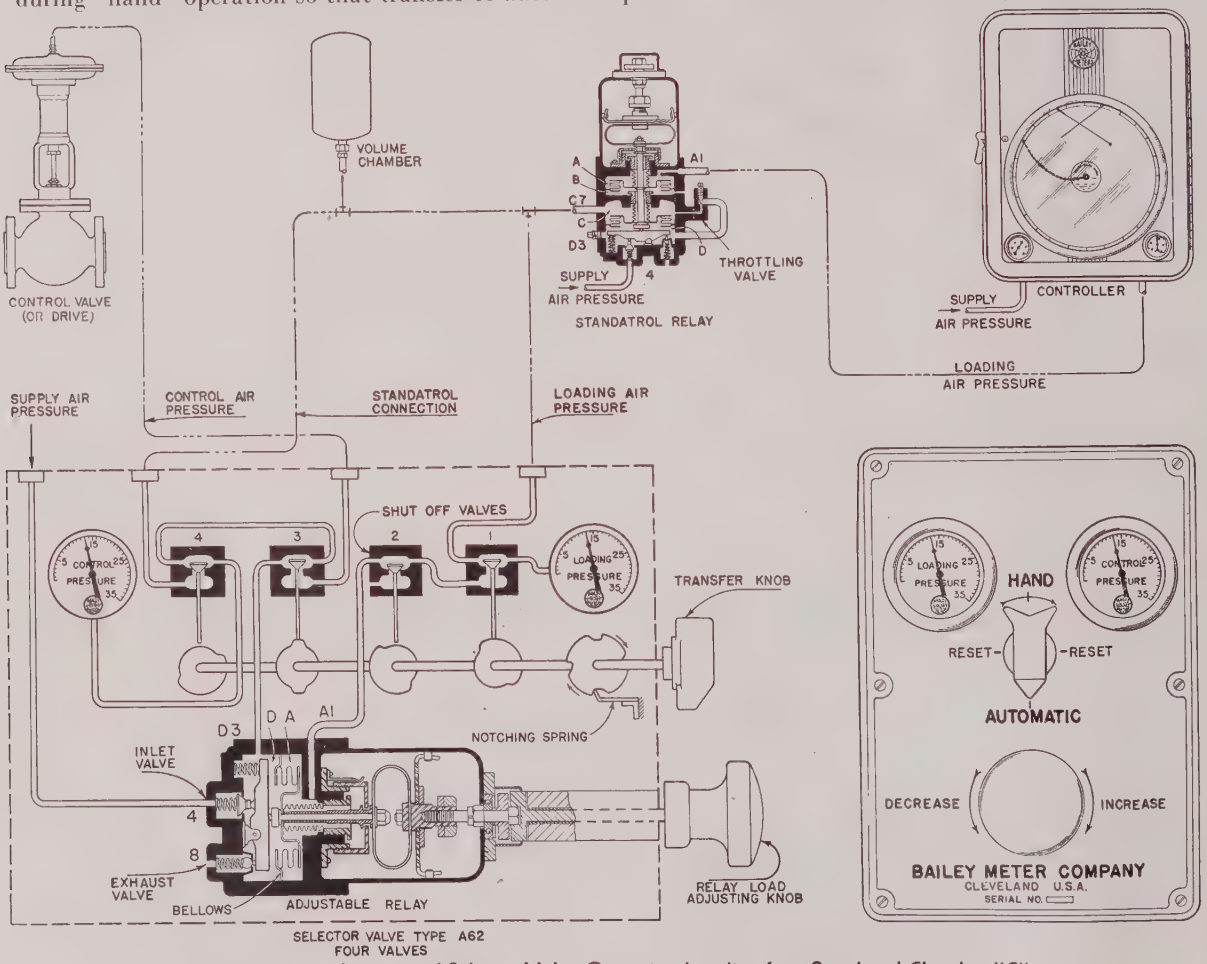


FIGURE 4 . . . Diagram of Selector Valve Operation Loading from Standatrol Chamber "C"

TRANSFER KNOB POSITION	SHUTOFF VALVE POSITION				SELECTOR VALVE OPERATION
	No. 1	No. 2	No. 3**	No. 4	
Hand	Closed	Open	Open	Open	The control air pressure is increased or decreased by turning the relay load adjusting knob.
Reset*	Open	Closed	Closed	Open	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from the "hand" position.
Automatic	Open	Closed	Open	Closed	The loading air pressure changes are reproduced in the control air pressure. However, the load adjusting knob may be turned to increase or decrease the relative value of control to loading pressure.
Reset*	Closed	Open	Closed	Closed	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from "automatic" position.

* Do not leave the transfer knob in reset position.

**No. 3 Shutoff valve operates before other valves.

OPERATION DIAGRAM FOR TYPE A 62-4 SELECTOR VALVE
When Used with an Averaging Relay.

A diagrammatic arrangement of the Type A62-4 Selector Valve is shown by Figure 5 for an application where the loading pressure is received from an averaging relay.

The transfer knob is shown in "automatic" position with shut-off valves 1 and 3 open, 2 and 4 closed. The loading pressures from two controllers are admitted to chambers "A" and "C" of the averaging relay. A modified loading pressure from chamber "D" of the averaging relay is admitted through shut-off valve 1 to chamber "A" of the adjustable relay where it is reproduced in chamber "D" and transmitted through shut-off valve No. 3 to the control valve (or drive).

When the transfer knob is in "hand" position, shut-off valves 2, 3 and 4 are open and 1 is closed.

Shut-off valve No. 4 is used to bypass the throttling valve on the averaging relay and is open during "hand" operation. The averaging relay chamber "C" air pressure is maintained the same as the controller number 2 loading pressure during "hand" operation so that transfer to "automatic" position can be made without delay.

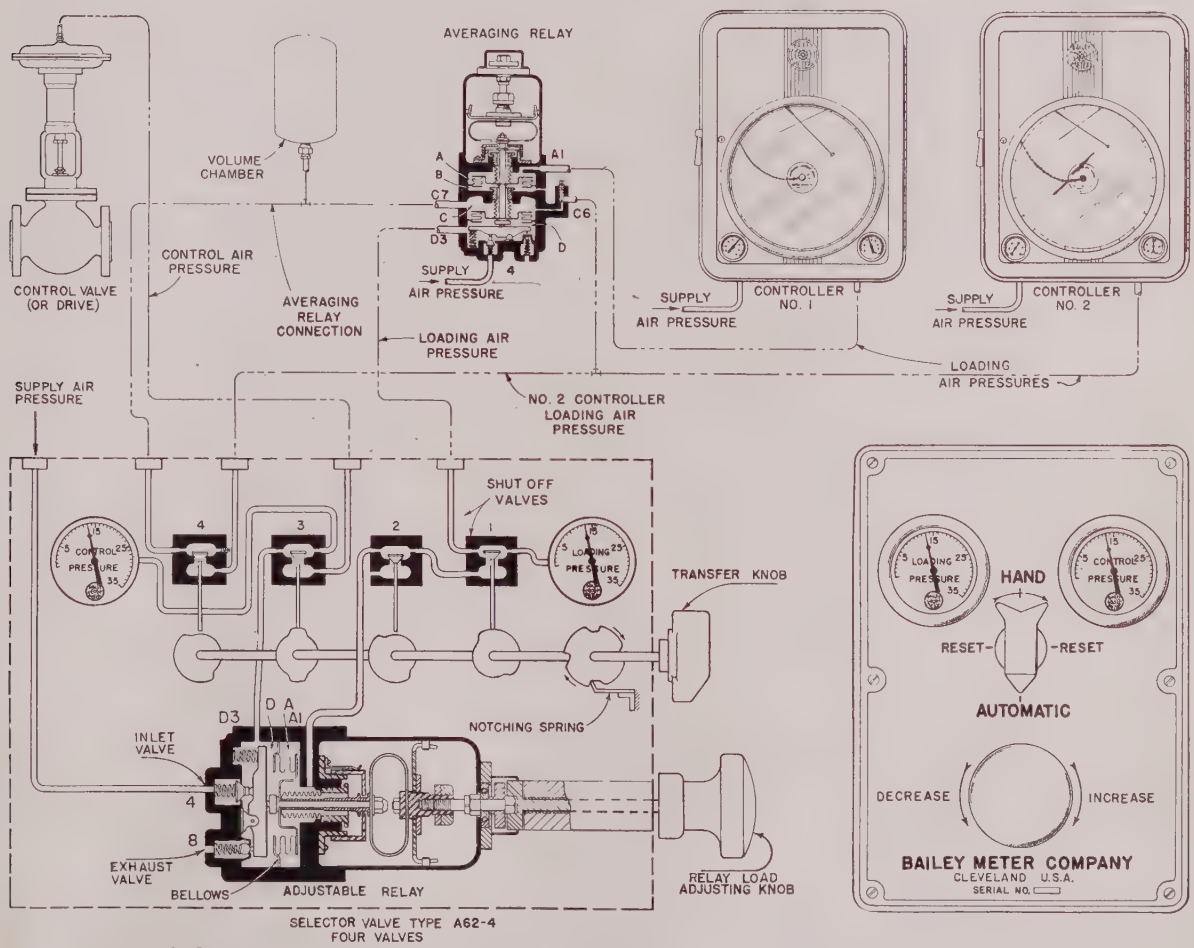


FIGURE 5 . . . Diagram of Selector Valve Operation When Used with an Averaging Relay

TRANSFER KNOB POSITION	SHUTOFF VALVE POSITION				SELECTOR VALVE OPERATION
	No. 1	No. 2	No. 3**	No. 4	
Hand	Closed	Open	Open	Open	The control air pressure is increased or decreased by turning the relay load adjusting knob.
Reset*	Open	Closed	Closed	Closed	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from the "hand" position.
Automatic	Open	Closed	Open	Closed	The loading air pressure changes are reproduced in the control air pressure. However, the load adjusting knob may be turned to increase or decrease the relative value of control to loading pressure.
Reset*	Closed	Open	Closed	Open	Turn the load adjusting knob until the control air pressure is equal to the observed control air pressure, prior to the transfer from "automatic" position.

* Do not leave the transfer knob in reset position.

**No. 3 Shutoff valve operates before other valves.

REMOTE MANUAL RELAY

TYPE A61

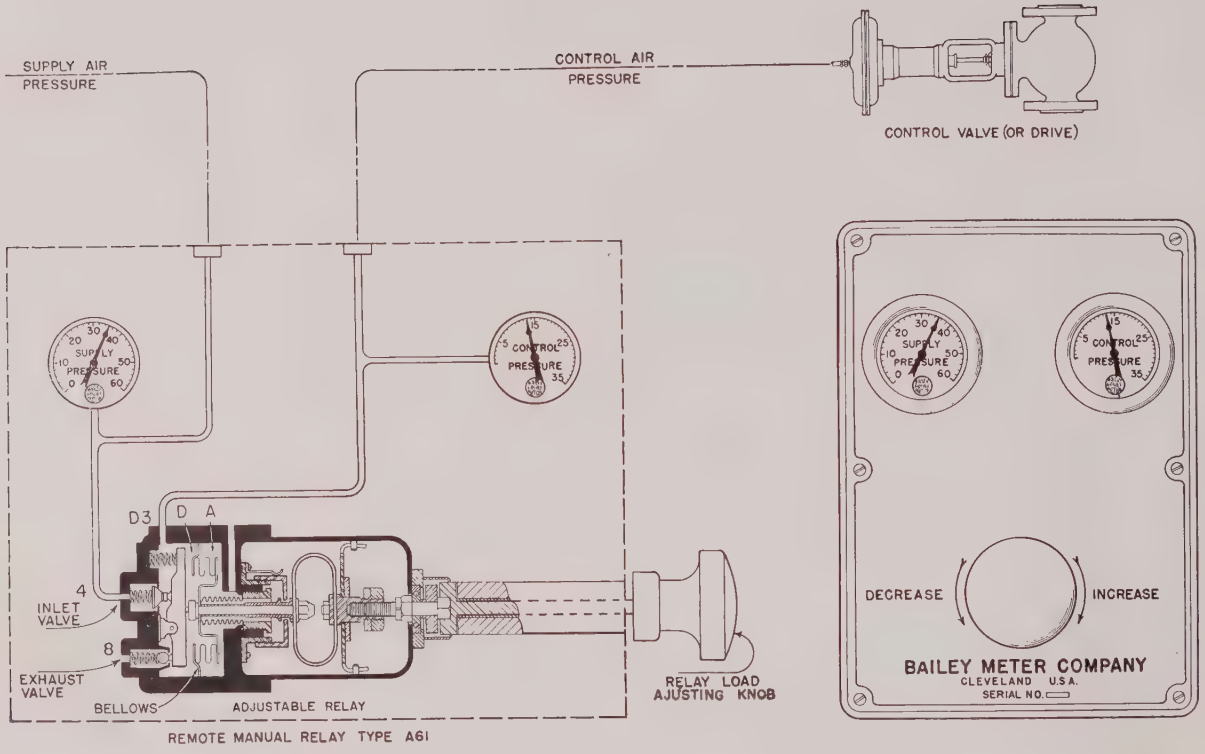


FIGURE 6

Remote Manual Relay Operation Diagram

The Type A61 remote manual relay is shown diagrammatically by Figure 6. It consists of an adjustable relay and pressure gages mounted on a face plate and arranged for manual adjustment of the control pressure which is used to position the control valve (or drive). The remote manual relay is used only when automatic operation is not required.

The supply air pressure, which is admitted to the inlet valve, is indicated by the supply pressure gage.

The air pressure applied to the control valve (or drive) is indicated by the control pressure gage.

The remote manual relay is operated by turning the relay load adjusting knob to increase or decrease the spring loading on the bellows. The bellows motion operates the inlet and exhaust valves in chamber "D" to increase or decrease the control pressure.

The adjustments of the remote manual relay, inlet and exhaust valves and bellows travel are the same as described for the selector valve.

SELECTOR VALVE ADJUSTABLE RELAY

ASSEMBLY AND ADJUSTMENTS

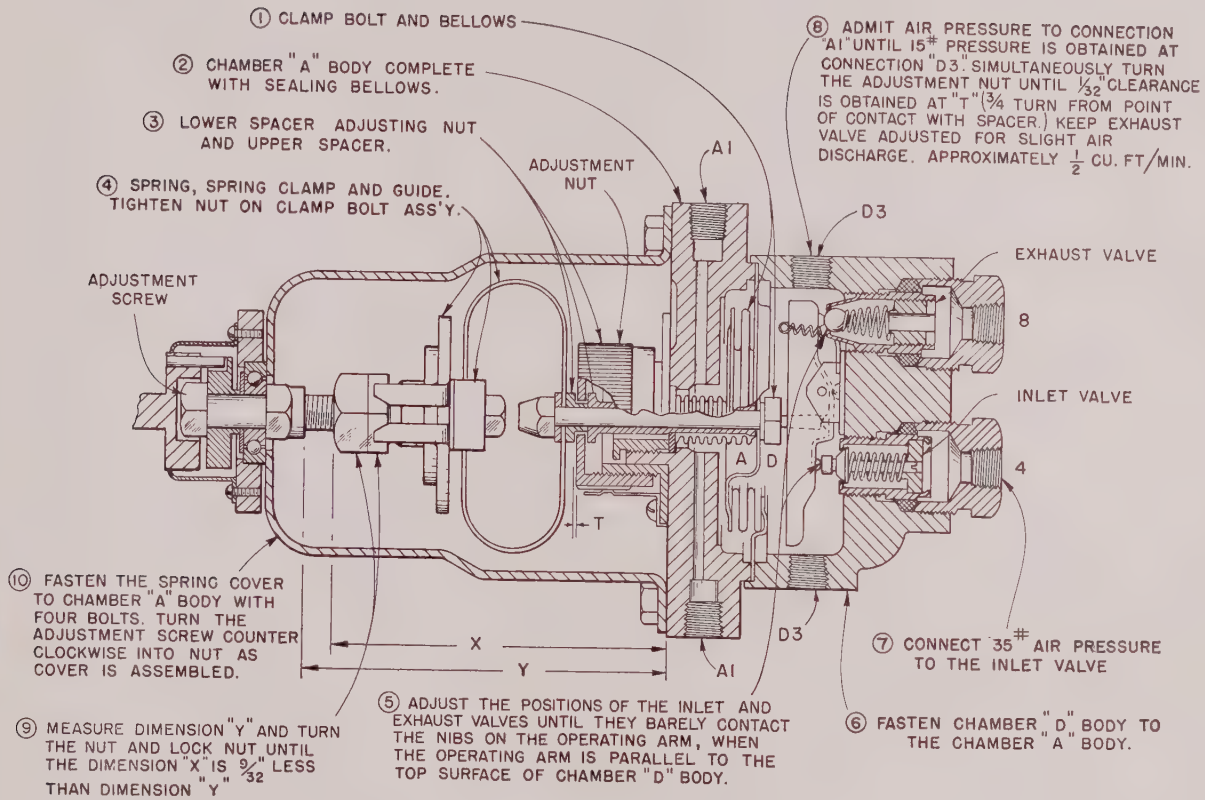

① CLAMP BOLT AND BELLOWS
② CHAMBER "A" BODY COMPLETE WITH SEALING BELLOWS.
③ LOWER SPACER ADJUSTING NUT AND UPPER SPACER.
④ SPRING, SPRING CLAMP AND GUIDE. TIGHTEN NUT ON CLAMP BOLT ASS'Y.
ADJUSTMENT SCREW
ADJUSTMENT NUT
A1
D3
⑧ ADMIT AIR PRESSURE TO CONNECTION "A1" UNTIL 15# PRESSURE IS OBTAINED AT CONNECTION "D3". SIMULTANEOUSLY TURN THE ADJUSTMENT NUT UNTIL 1/32" CLEARANCE IS OBTAINED AT "T" (3/4 TURN FROM POINT OF CONTACT WITH SPACER.) KEEP EXHAUST VALVE ADJUSTED FOR SLIGHT AIR DISCHARGE. APPROXIMATELY 1/2 CU. FT/MIN.
EXHAUST VALVE
8
INLET VALVE
4
A
D
T
X
Y
D3
A1
⑦ CONNECT 35# AIR PRESSURE TO THE INLET VALVE
⑥ FASTEN CHAMBER "D" BODY TO THE CHAMBER "A" BODY.
⑩ FASTEN THE SPRING COVER TO CHAMBER "A" BODY WITH FOUR BOLTS. TURN THE ADJUSTMENT SCREW COUNTER CLOCKWISE INTO NUT AS COVER IS ASSEMBLED.
⑨ MEASURE DIMENSION "Y" AND TURN THE NUT AND LOCK NUT UNTIL THE DIMENSION "X" IS 9/32" LESS THAN DIMENSION "Y"
⑤ ADJUST THE POSITIONS OF THE INLET AND EXHAUST VALVES UNTIL THEY BARELY CONTACT THE NIBS ON THE OPERATING ARM, WHEN THE OPERATING ARM IS PARALLEL TO THE TOP SURFACE OF CHAMBER "D" BODY.

FIGURE 7

Selector Valve Adjustable Relay

The complete assembly of the selector valve is shown by Figure 9, together with sectional views of the adjustable relay, shut-off valves and notching spring. A sectional view of the adjustable relay shown by Figure 7 has been marked for the correct assembly and adjustment procedure in numerical order 1 to 10. The numerical order would be reversed if it is desired to disassemble the adjustable relay.

A sealing cement such as Tite Seal must be used on each side of the bellows flange during assembly in order that the completed assembly will be pressure tight. The flanges which require the sealing cement are indicated by the side sectional view of the Selector Valve by Figure 9.

MAINTENANCE

(1) The air pressure gages should give accurate readings or be replaced.

(2) If air leakage occurs through shut-off valves, replace the air valve assembly. Parts Nos. 53225-1 and 535199-1. The shut-off valves may be checked for air leakage by connecting a 28 pound air supply pressure to the lower connection and observing if air leakage occurs at either of the two top connections.

(3) To clean the inlet and exhaust valves, the chamber "D" section should be removed and the inlet and exhaust valves cleaned by washing with a common solvent such as carbon tetrachloride. After the valves have been cleaned, it is essential that the inlet and exhaust valve positions be returned to the same relation with the operating arm in order that the travel adjustment will be correct. (See adjustment No. 5 Figure 7.) Adjust the exhaust valve for a very slight air leakage and check the operation of the relay by applying air loading pressures to chamber "A". Any adjustments which may be required should be made as described under adjustments. The leakage at the exhaust port should be about ½ cubic foot per minute.

(4) All air connections must be air tight.

(5) The cams must not contact the push rods when the shut-off valves are in the closed position. In open position, the push rods should be lifted 1/16" by the cams. The shut-off valve bodies may be adjusted up or down to obtain the necessary clearance and lift after loosening the mounting screws. The open and closed positions of the shut-off valves may be obtained from the tabulation shown under the operation diagrams.

MOUNTING AND CUTOUT DIMENSIONS

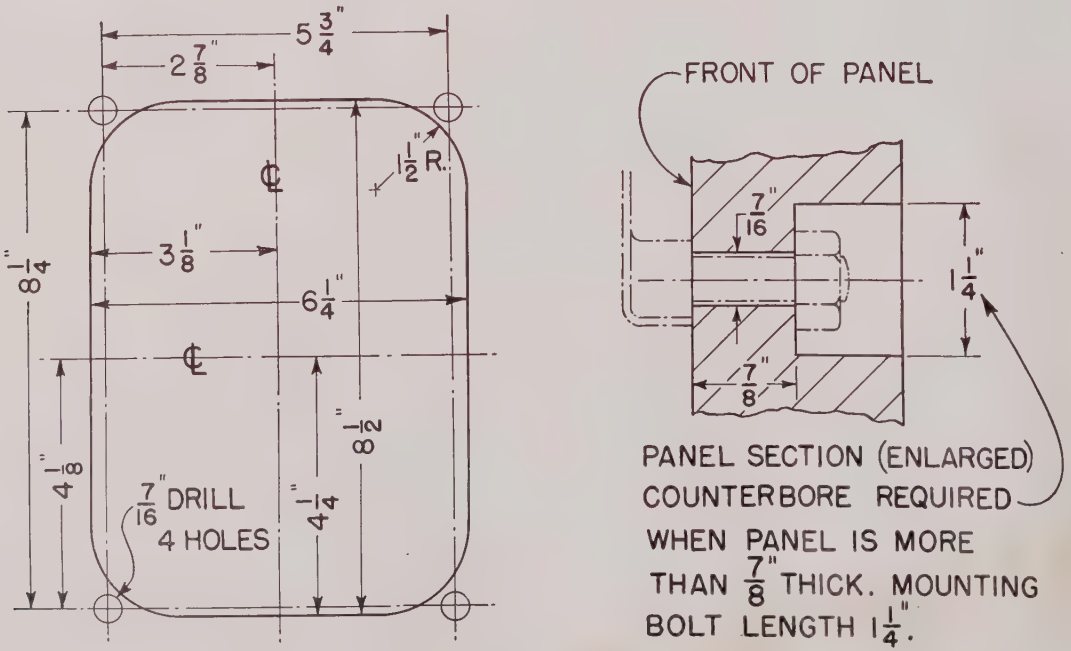
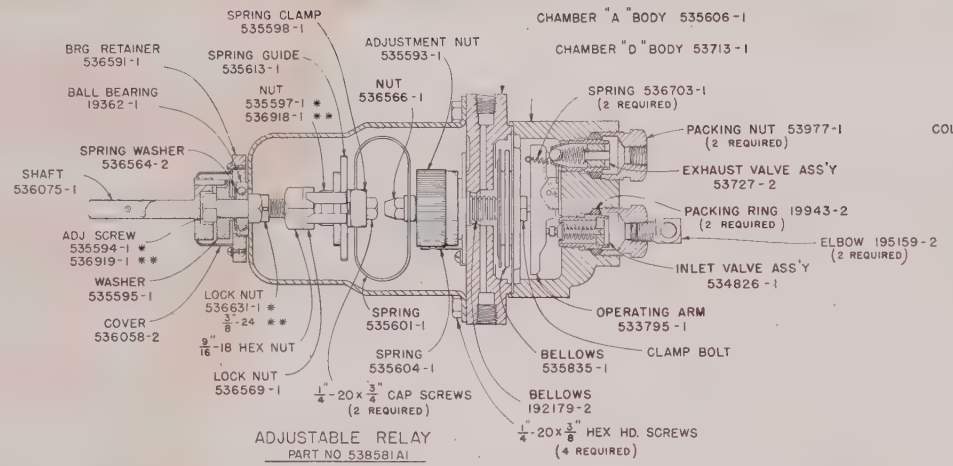
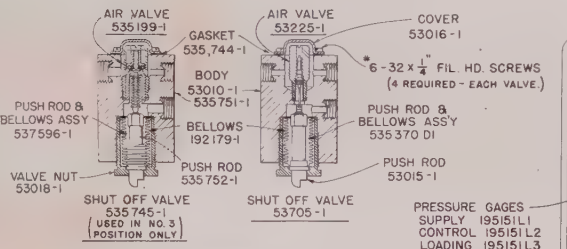


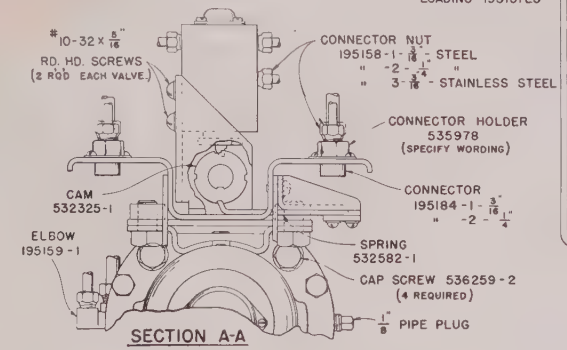
FIGURE 8

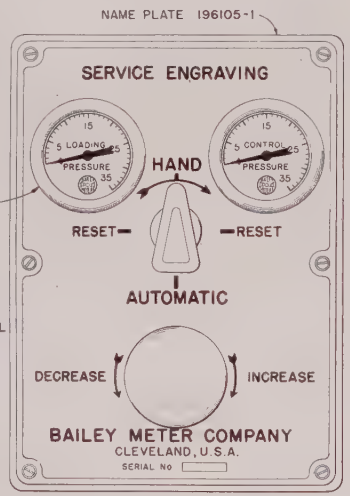
Panel Cutout and Mounting Dimensions for Selector Valves and Remote Manual Relay



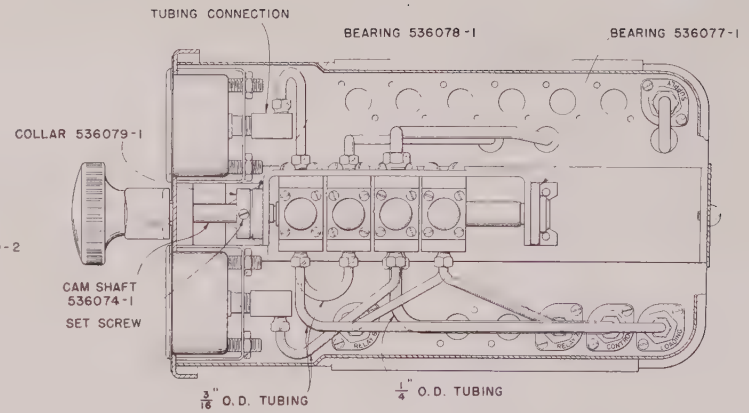
ADJUSTABLE RELAY
PART NO 538581A1


AIR VALVE 535199-1
GASKET 535,744-1
BODY 53010-1 535751-1
BELLOWS 192179-1
PUSH ROD 535752-1
VALVE NUT 53018-1
PUSH ROD & BELLOWS ASSY 537596-1
SHUT OFF VALVE 535745-1 (USED IN NO.3 POSITION ONLY)
AIR VALVE 53225-1
COVER 53016-1
*6-32 x 1/4" FIL HD. SCREWS (4 REQUIRED - EACH VALVE.)
PUSH ROD & BELLOWS ASS'Y 535370 D1
PUSH ROD 53015-1
SHUT OFF VALVE 53705-1

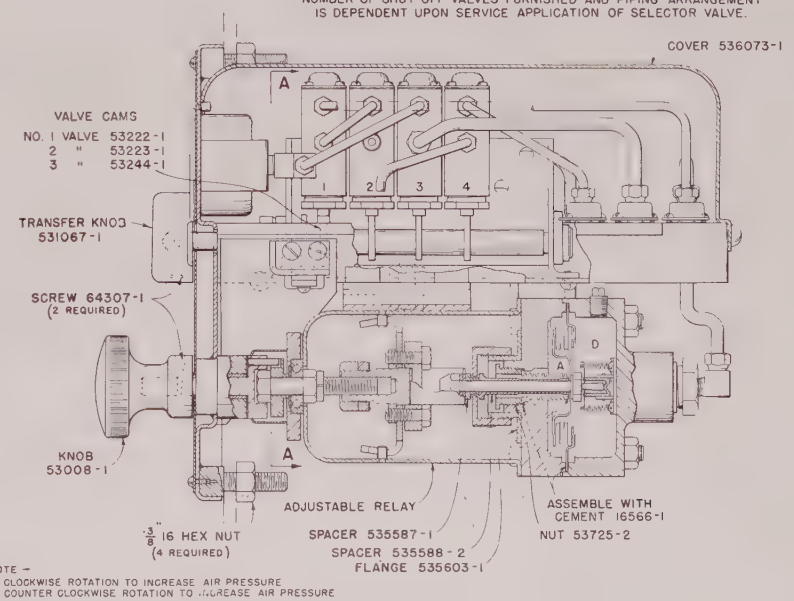




BAILEY SELECTOR VALVE



NUMBER OF SHUT OFF VALVES FURNISHED AND PIPING ARRANGEMENT IS DEPENDENT UPON SERVICE APPLICATION OF SELECTOR VALVE.



NOTE -
* CLOCKWISE ROTATION TO INCREASE AIR PRESSURE
** COUNTER CLOCKWISE ROTATION TO INCREASE AIR PRESSURE

FIGURE 9
Specify Serial Number When Ordering Parts

PRODUCTS

BOILER METERS
BOILER WATER LEVEL RECORDERS
COAL METERS
COMBUSTION CONTROL
DRAFT CONTROLLERS
FEED WATER CONTROL
FLAME DETECTORS
FLOW CONTROLLERS
FLUID METERS
LIQUID LEVEL RECORDERS
MULTI-POINTER GAGES
PYROMETERS
PRESSURE CONTROLLERS
PRESSURE RECORDERS
RESISTANCE THERMOMETERS
SEWAGE METERS
SMOKE RECORDERS
TELEMETERING SYSTEMS
TEMPERATURE CONTROLLERS
TEMPERATURE RECORDERS
V-NOTCH WEIR METERS
VENTURI TUBES

BRANCH OFFICES

BOSTON
NEW YORK
PHILADELPHIA
BUFFALO
PITTSBURGH
DETROIT
CINCINNATI
ATLANTA
CHICAGO
MILWAUKEE
ST. LOUIS
ST. PAUL
KANSAS CITY
HOUSTON
DENVER
LOS ANGELES
SEATTLE
SAN FRANCISCO
MONTREAL
WINNIPEG
TORONTO

BAILEY METER COMPANY

1050 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

5M PRINTED IN U. S. A. 2-45

INSTRUCTIONS FOR BAILEY AIR OPERATED CONTROL

SECTION AC 325
DIAPHRAGM OPERATED REGULATING VALVE OR DRIVE

DESCRIPTION OF EQUIPMENT

The general arrangement of the Bailey Diaphragm Operated Regulating Valve is shown by Figure 1. Air pressure applied above the diaphragm operates against a spring to open or close the valve, depending on the type of inner valve assembly used. Inner valve details, flowing conditions, body details, etc., are given on Data Sheet No. AC 325.

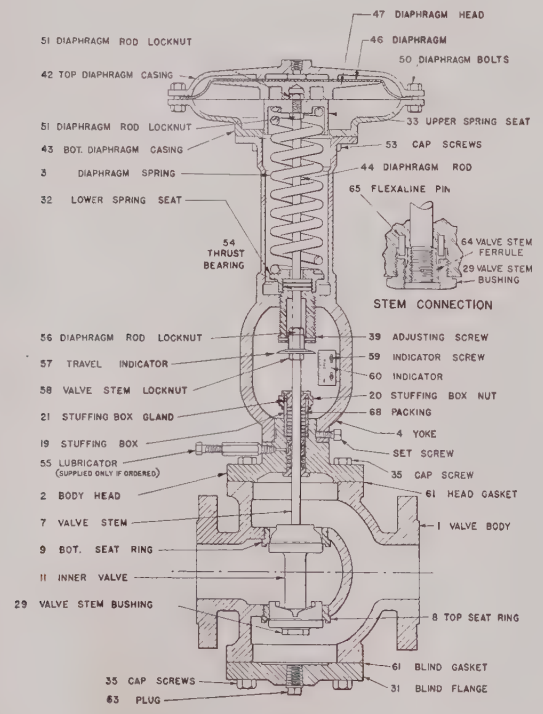


FIGURE 1

INSTALLATION

The valve may be installed in the pipe line with the diaphragm head in any position, though if possible, the diaphragm head should be above the valve body. Where special construction is used in the valve body or inner valve, or where the diaphragm motor is used for other purposes, see the assembly drawing specified on data sheet AC 325.

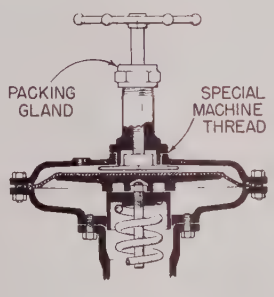
The air connection should be made in accordance with the pipe diagram specified on the data sheet. The diaphragm head is provided with a pipe tap for this connection. The piping should be installed in accordance with Section No. AC 001 of these instructions.

ADJUSTMENT

The diaphragm travel and the range of loading pressure required to produce this travel are given on Data Sheet No. AC 325. For any given diaphragm and spring assembly, this relation cannot be changed. However, the loading pressure at which the diaphragm starts to move can be varied by turning the adjusting screw beneath the spring. Turning the screw in a right-hand direction increases the spring tension to increase the loading pressure required to start moving the diaphragm.

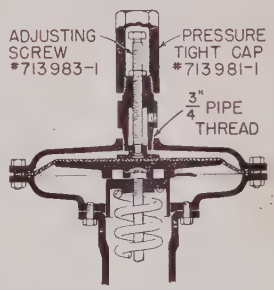
HANDWHEEL JACK (Included only when ordered)

Where manual control of the regulating valve is desired, a hand-wheel jack is furnished, the details of which are shown by Figure 2. Where it is necessary that the handwheel jack also act as a minimum stop to prevent the valve from closing or opening beyond a predetermined point, on decreasing air pressure, washers can be inserted beneath the handjack to restrict the manual operation to a limited part of the valve travel. In order to do this the upper diaphragm casing must be removed and the pusher plate removed from the handjack screw.



HAND JACK ASSEMBLY

FIGURE 2



ADJUSTABLE STOP ASSEMBLY #713982 B1

FIGURE 3

ADJUSTABLE STOP (Included only when ordered)

This stop is shown by Figure 3. The stop screw, part No. 713983-1, is adjusted to bear against the valve diaphragm to hold the valve open the desired amount. Once this adjustment is made, it can be locked in position by the jam nut. Following adjustment, the cap, part No. 713981-1, should be screwed down tightly to prevent air leakage.

POSITIONER RELAY (Included only when ordered)

The general assembly of the positioner relay is shown in Figure 4. The loading line is connected to connection 5 and the supply line to connection 8 of the positioner. (See Instruction AC 150).

In operation, an increase in loading pressure forces the bellows and center post assembly upward to open the air inlet valve and close the exhaust air valve in the lower chamber, thus building up the air pressure in the lower chamber which is transmitted from there to the upper side of the diaphragm housing. As the diaphragm moves downward, the spring loading above the positioner bellows is increased until the spring loading balances the air pressure loading and the diaphragm reaches a stationary position.

On a decrease in loading pressure, the reverse operation exists. A decrease in loading pressure allows the center post of the positioner bellows assembly to move downward, closing the air inlet valve and opening the exhaust air valve, thereby relieving the pressure in the lower chamber of the positioner and in the diaphragm housing. As the diaphragm moves upward, the positioner spring loading is decreased, allowing the center post assembly to move upward and to close the exhaust air valve of the positioner.

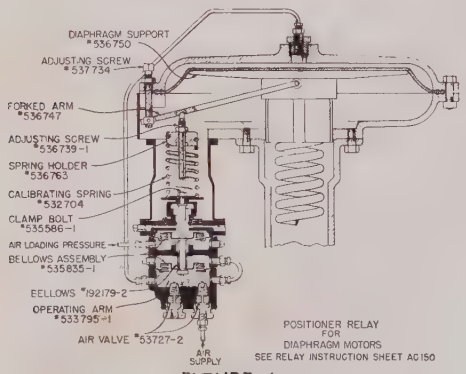


FIGURE 4

In referring to Figure 4, note that the pressures on either side of the lower bellows are equalized so that no force is applied to the center post by this bellows.

The positioner is properly adjusted at the factory so that no field adjustment should be necessary, but should the factory adjustment be disturbed the zero adjusting screw No. 537734 should be altered to determine the loading pressure at which the regulating valve will start to move. This is normally adjusted for 5 lb. loading pressure but in the case of special valves this information will be given on Data Sheet No. AC 325. If the regulating valve starts to move at too low a loading pressure the zero adjusting screw No. 537734 should be rotated clockwise.

To alter the range of air pressure required for full diaphragm travel remove the positioner from the diaphragm housing and change the active length of the calibrating spring No. 532704 by rotating the spring with respect to the spring holder No. 536763. An increase in the active length of the spring decreases the range of air pressure required for full travel of the diaphragm. After adjusting the spring rate relocate adjusting screw No. 536739-1 so the end of the fork lever positioned by adjusting screw No. 537734 is somewhere near the middle of its travel when the proper relation between loading pressure and valve travel is obtained.

Care should be used not to disturb the position of the air inlet and exhaust valve of the positioner. If these air valves must be removed for cleaning, remove one valve at a time, first measuring its position from the machined surface. Replace valve and locate as near as possible to original location. Then adjust exhaust air valve, with positioner operating, to obtain the original air leakage.

MAINTENANCE

It is necessary that the diaphragm head be absolutely tight to prevent air leakage at this point. This can be tested by application of a soap suds solution to the joint of the diaphragm head while the unit is under pressure.

In packing the stuffing box, the use of cotton wick packing is not recommended. Either use a formed ring packing or a good grade of twisted graphited asbestos packing. When properly packed, the stuffing box should hold the pressure by being tightened with only the thumb and forefinger. A wrench or pliers should never be used.

SPARE PARTS LIST

If it is necessary to replace a diaphragm, remove the air lines and upper diaphragm casing, after which the diaphragm may be removed. Before doing this it is best to relieve the tension on the spring by backing off the spring adjusting nut. This can easily be readjusted after the diaphragm has been changed in the manner described under "Adjustment".

It is recommended that one diaphragm (part number given on Figure 1) per three similar valves be carried in stock.

If a greasing connection has been provided with the stuffing box, orders for additional stick grease should specify whether grease is to be used for valves passing water, steam or oil.

In some cases, it is advisable to carry spare inner valve parts. This is true where either the nature of the flow or the fluid creates an errosive or corrosive action within the valve. Periodic inspection of the inner valve parts will determine the advisability of carrying these spare parts.

If the valve is equipped with a valve positioner, one bellows, No. 535835-1, one bellows, No. 192179-2 and one air valve, No. 53727-2, per three identical valves, should be carried in stock.

When ordering spare parts specify valve size and serial number and use nomenclature on Figure 1.

BAILEY METER COMPANY • Cleveland, Ohio
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INSTRUCTIONS

SECTION AC 410

FOR ADJUSTMENT AND OPERATION OF

BAILEY RECORDER-CONTROLLER

FOR PRESSURE AND TEMPERATURE
TYPE K35

BAILEY METER COMPANY
CLEVELAND 10, OHIO

RECORDER-CONTROLLER

TYPE K35 CLASS 2-2AP FOR PRESSURE
TYPE K35 CLASS 4-4AP FOR TEMPERATURE

The general assembly of the Bailey Type K35, Class 2-2AP Pressure Recorder-Controller, or Type K35, Class 4-4AP Temperature Recorder-Controller is shown by Figure 1.

The controller has two inter-connected mlutiturn Bourdon tube helices, which have the movable ends connected through linkage so that the upper helix operates the recording pen and the lower helix operates the air pilot valve.

Space is provided for two additional helices which may be used to record additional pressures or temperatures on the same chart.

A change in pressure, if the controller is used for control of pressure, or a change in temperature when the controller is used for control of temperature, will produce simultaneous movement of the helices. The upper helix will record the pressure or temperature change on the chart. The motion of the lower helix will be transmitted to the pilot valve stem through the pilotrol linkage. Movement of the pilot valve stem establishes air loading pressures which actuate the control drive or valve to maintain the pressure or temperature at some predetermined control standard. This control standard is indicated on the chart by the position of the standard pointer.

The normal range of air loading pressure, which is required to move a control valve or drive through full travel, is 5 to 25 lb. The controller linkage is normally adjusted so that when the recording pen and standard pointer conincide, the air loading pressure will be indicated at 15 by the loading pressure gage. The air supply pressure to the controller is indicated by the supply pressure gage, and this pressure must be kept constant at 35. The air pressure gages indicate air pressure in pounds per square inch.

OPERATING ADJUSTMENTS

The controller is provided with two operating adjustments which are "control standard" and "regulating range".

Control Standard Adjustment — The standard adjustment is shown by Figure 1, and may be turned to change the control operating standard. This adjustment is connected through linkage to the standard indicator pointer so that any change in the standard adjustment will be indicated on the chart by the standard pointer.

Regulating Range Adjustment — The regulating range adjustment is shown by Figure 1 and consists of an adjustable pivot which may be moved to the

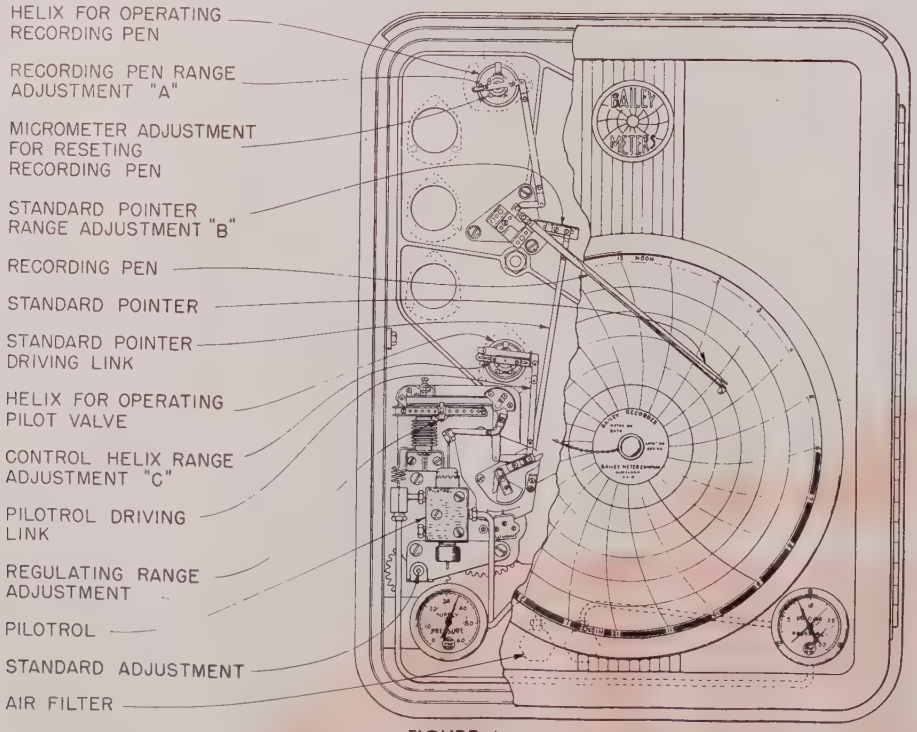


FIGURE 1

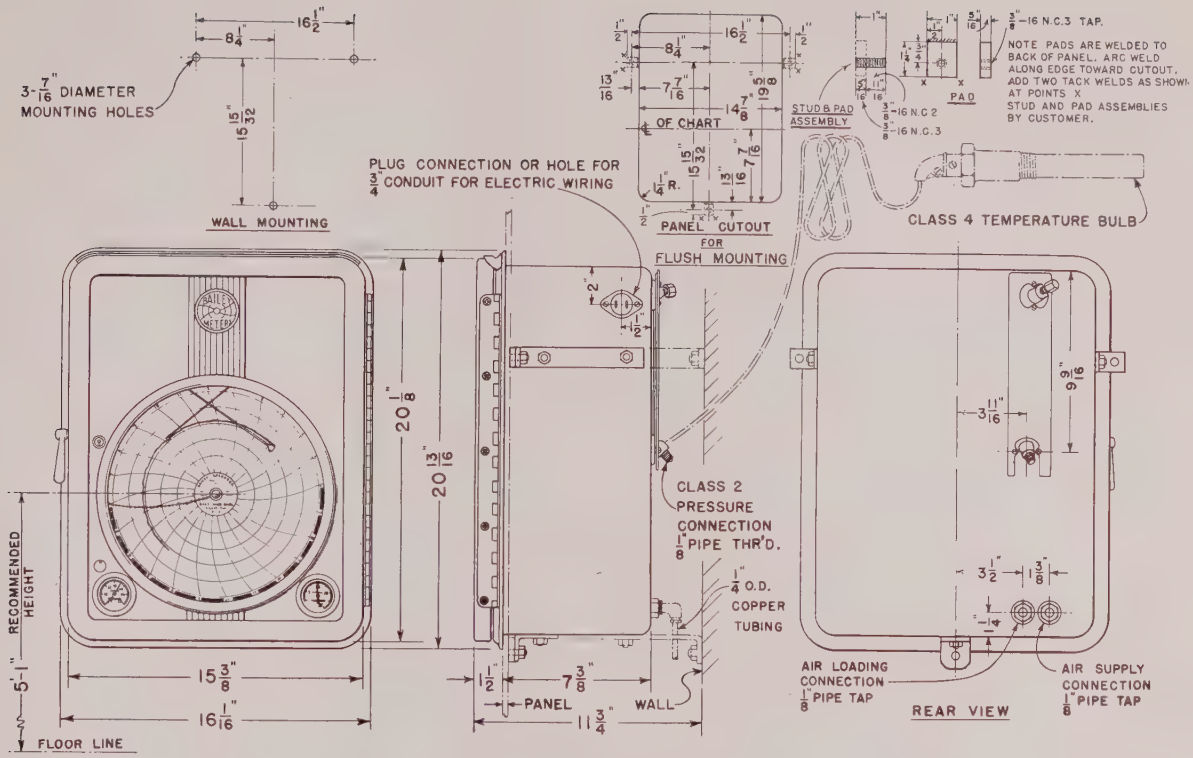

3-7/16" DIAMETER MOUNTING HOLES
WALL MOUNTING
PLUG CONNECTION OR HOLE FOR 3/4" CONDUIT FOR ELECTRIC WIRING
PANEL CUTOUT FOR FLUSH MOUNTING
OF CHART
STUD & PAD ASSEMBLY
PAD
3/8-16 N.C.2
3/8-16 N.C.3
3/8-16 N.C.3 TAP.
NOTE PADS ARE WELDED TO BACK OF PANEL. ARC WELD ALONG EDGE TOWARD CUTOUT. ADD TWO TACK WELDS AS SHOWN AT POINTS X. STUD AND PAD ASSEMBLIES BY CUSTOMER.
CLASS 4 TEMPERATURE BULB
CLASS 2 PRESSURE CONNECTION 1/8" PIPE THR'D.
1/4" O.D. COPPER TUBING
RECOMMENDED HEIGHT
5'-1"
FLOOR LINE
PANEL
WALL
AIR LOADING CONNECTION 1/8" PIPE TAP
AIR SUPPLY CONNECTION 1/8" PIPE TAP
REAR VIEW

FIGURE 2

right to increase the regulating range, or to the left to decrease the regulating range. It is recommended that the adjustable pivot be located over the eighth hole from the left in the beam when starting the control operation. Adjust the control by decreasing the regulating range to a point just short of that where unstable control operation is obtained. Reference should be made to Figure 3, Page 6 of the Pilotrol Instructions AC 100 for the regulating range characteristic curves.

If the controller loading pressure is applied to a standatrol relay, the throttling valve adjustment on the standatrol should be used to supplement the regulating range adjustment on the Pilotrol. Turning the standatrol throttling valve stem counter-clockwise will increase the rate of control pressure change to the control drive or valve for the same deviation in controller loading pressure. However, the throttling valve adjustment on the standatrol must not be made simultaneously with the regulating range adjustment in the controller since either adjustment may be used to regulate the rate of change in the control pressure to the control drive or valve. The regulating range adjustment in the controller determines the amount of loading pressure change for a given deviation of the pressure or temperature from the operating standard, whereas the throttling valve adjustment on the standatrol determines the rate of control pressure change for the same loading pressure change.

INSTALLATION

The mounting dimensions for both panel and wall mounting of the controller are shown by Figure 2.

A ⅛-inch IPS pressure connection to the Bourdon tube is provided on the back of Type K35 Class 2-2AP Pressure Controller case.

The Type K35 Class 4-4AP Temperature Controller is shipped with the Bourdon tube installed in the controller case and with the capillary which connects the Bourdon tube to the bulb, coiled and fastened to the back of the controller case. The capillary tubing must be carefully uncoiled after the controller has been mounted and run as directly as possible to the location where the bulb is to be installed. Since the bulb, capillary and Bourdon tube have been charged with gas at a definite pressure and temperature, their installation should be carefully made in order that injury to the system will be avoided. The loss of gas from the system or a restriction in the capillary would prevent the temperature unit from operating satisfactorily.

If additional temperature recorders are included with either a pressure or temperature controller, the additional recording helices are removed from the controller case for shipment.

Remove the bulb from the flanged bushing or separable socket before installing the flanged bushing or separable socket in the pipe.

Copper tubing and suitable fittings are recommended for connecting to the air supply and air loading pressure connections on the back of the controller case. The air connections should be made in accordance with the control piping diagram which is furnished for each control system.

CALIBRATING ADJUSTMENTS

Reference to Figure 1 will show adjustments which have been indicated by letters A, B and C. These adjustments have been fixed during the calibration of the controller at the factory. It will not be necessary to alter these adjustments except on replacement of the Pilotrol assembly or Bourdon tube helices.

These adjustments have been made so that a reading of 15 is obtained on the loading pressure gage when the recording pen and standard pointer are coincident. Mid-scale position of the standard pointer should correspond to mid-scale position of the standard sector on the pilotrol.

The micrometer adjustments which are provided on the helices are used to reset the recording pen and pilotrol driving link. The standard pointer is adjusted to indicate the correct pressure or temperature on the chart which will be maintained by the control.

The calibration of the Pilotrol linkage is included on Page 5 of the Pilotrol Instructions, Section AC 100.

MAINTENANCE

1. The adjustment and maintenance of the pilotrol is covered by Section AC 100.
2. The connecting linkage should operate freely without binding. If any parts are found to have undue friction, remove the affected parts and clean with a common solvent such as carbon tetrachloride.
3. The air pressure connections and piping must be kept air tight since very small leaks will cause considerable error in the loading pressure, and erratic control operation.
4. The Pressure Gages should give correct readings or be replaced.
5. Reference should be made to Figure 3 for replacement parts.

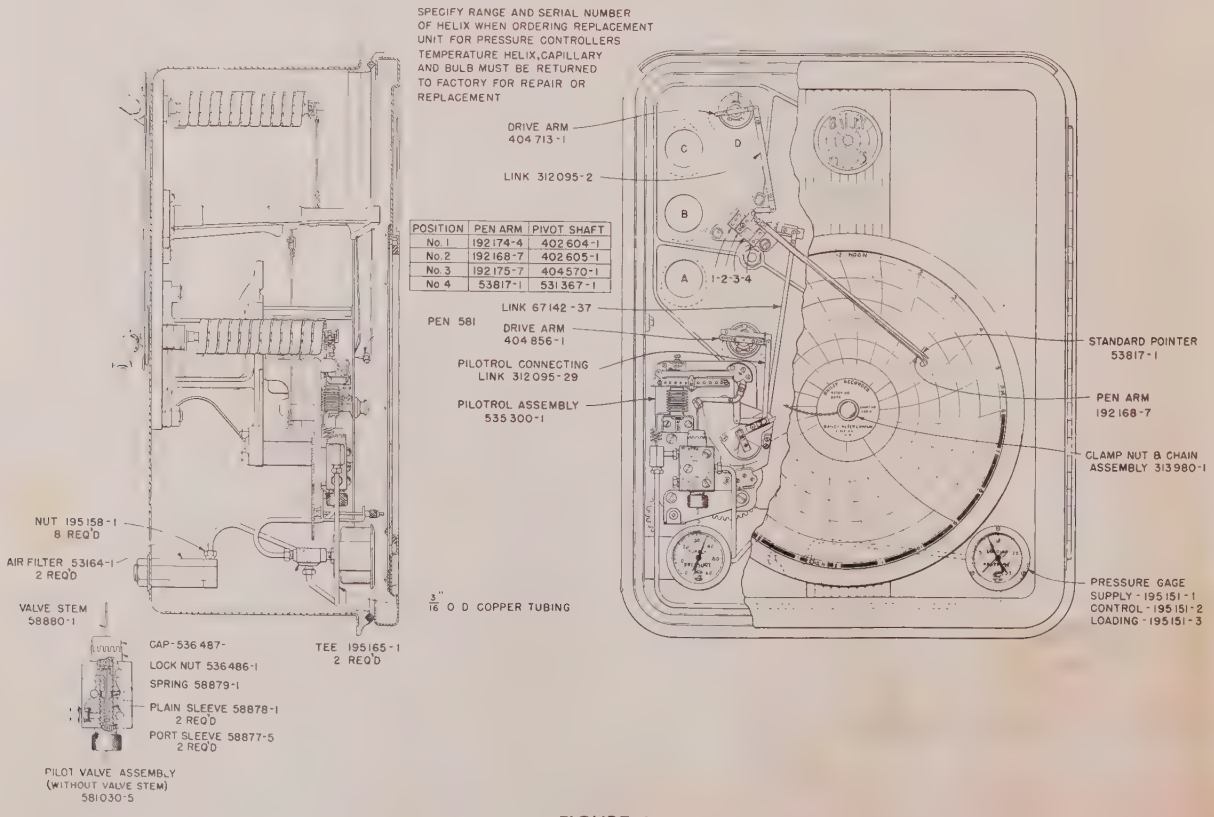

SPECIFY RANGE AND SERIAL NUMBER OF HELIX WHEN ORDERING REPLACEMENT UNIT FOR PRESSURE CONTROLLERS TEMPERATURE HELIX, CAPILLARY AND BULB MUST BE RETURNED TO FACTORY FOR REPAIR OR REPLACEMENT
DRIVE ARM 404713-1
LINK 312095-2
POSITION | PEN ARM | PIVOT SHAFT
No. 1 | 192174-4 | 402604-1
No. 2 | 192168-7 | 402605-1
No. 3 | 192175-7 | 404570-1
No. 4 | 53817-1 | 531367-1
LINK 67142-37
PEN 581
DRIVE ARM 404856-1
PILOTROL CONNECTING LINK 312095-29
PILOTROL ASSEMBLY 535300-1
STANDARD POINTER 53817-1
PEN ARM 192168-7
CLAMP NUT & CHAIN ASSEMBLY 313980-1
PRESSURE GAGE SUPPLY - 195151-1 CONTROL - 195151-2 LOADING - 195151-3
NUT 195158-1 8 REQ'D
AIR FILTER 53164-1 2 REQ'D
VALVE STEM 58880-1
5/16 O D COPPER TUBING
TEE 195165-1 2 REQ'D
CAP-536487-
LOCK NUT 536486-1
SPRING 58879-1
PLAIN SLEEVE 58878-1 2 REQ'D
PORT SLEEVE 58877-5 2 REQ'D
PILOT VALVE ASSEMBLY (WITHOUT VALVE STEM) 581030-5

FIGURE 3

BAILEY METER COMPANY
CLEVELAND, OHIO

4M PRINTED IN U. S. A. 2-45

INSTRUCTIONS

SECTION AC 450

FOR ADJUSTMENT AND OPERATION OF

BAILEY RECORDER-CONTROLLERS

FOR FLOW CONTROL

TYPES C, CA, CH, CG AND CS

BAILEY METER COMPANY

CLEVELAND, OHIO

FLOW RECORDER-CONTROLLERS

The general assembly of the Bailey Type C, CA, CH, CG, and CS Flow Recorder-Controllers is shown by Figure 1.

The controller consists of a flow or differential mechanism which operates through a pressure tight bearing, and linkage to position the Pilotrol as shown in the diagrammatic drawing Figure 1. Sectional drawings of the various types of flow mechanisms are shown in Figures 2, 3, 4, 5 and 6. A separate set of instructions should be consulted for details regarding their construction and operation.

A change in the rate of flow produces a movement of the flow mechanism which is transmitted to the recording pen. This motion of the flow mechanism is also transmitted to the pilot valve stem through the meter drive arm and Pilotrol linkage.

Each movement of the pilot valve stem establishes a new air loading pressure which actuates the control drive or valve to maintain the flow at some predetermined rate. This rate, known as the control standard, is indicated on the recording chart by the position of an indicating pointer. It may be easily set to any desired rate by use of the Pilotrol standard adjustment.

The controller linkage is normally adjusted so that when the recording pen and the control standard pointer coincide, the air loading pressure will be at 15 lb. as indicated by the loading pressure gage.

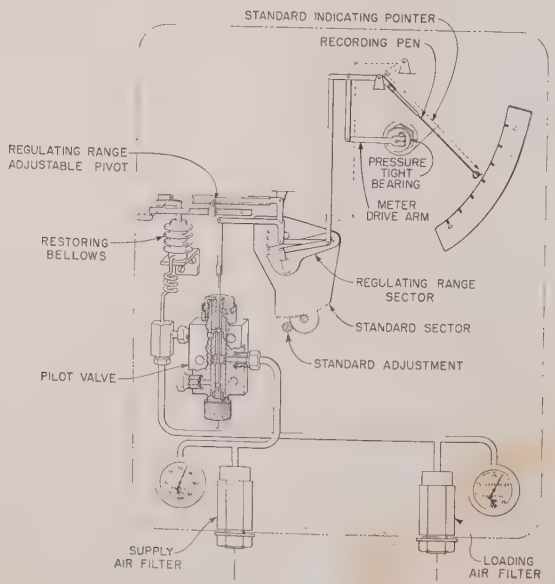


FIGURE 1 — Diagrammatic Arrangement of Bailey Flow Recorder-Controller.

B. M. CO. 5-42 2M PRINTED IN U. S. A.

The normal range of air loading pressure which is required to move a control valve or drive through full travel is 5 to 25 lb.

The air supply pressure to the controller must be kept constant at 35 lb. per sq. in. It is indicated by the supply pressure gage.

OPERATING ADJUSTMENTS

The controller is provided with two operating adjustments which are "control standard" and "regulating range".

Control Standard Adjustment — The standard adjustment is shown by Figure 1, and may be turned to change the control operating standard. This adjustment is connected through linkage to the standard indicator pointer so that any change in the standard adjustment will be indicated by the standard pointer.

Regulating Range Adjustment — The regulating range adjustment is shown by Figure 1 and consists of an adjustable pivot which may be moved to the right to increase the regulating range, or to the left to decrease the regulating range. It is recommended that the adjustable pivot be located over the eighth hole from the left in the beam when starting the control operation. Adjust the control by decreasing the regulating range to a point just short of that where unstable control operation is obtained. Reference should be made to Figure 3, Page 6 of the Pilotrol Instructions AC 100 for the regulating range characteristic curve.

If the controller loading pressure is applied to a standatrol relay, the throttling valve adjustment on the standatrol should be used to supplement the regulating range adjustment on the Pilotrol. Turning the standatrol throttling valve stem counter-clockwise will increase the rate of control pressure change to the control drive or valve for the same deviation in controller loading pressure. However, the throttling valve adjustment on the standatrol must not be made simultaneously with the regulating range adjustment in the controller since either adjustment may be used to regulate the rate of change in the control pressure to the control drive or valve. The regulating range adjustment in the controller determines the amount of loading pressure change for a given deviation of flow from the operating standard, whereas the throttling valve adjustment on the standatrol determines the rate of control pressure change for the same loading pressure change.

INSTALLATION

The recorder-controller should be installed in accordance with instructions for flow elements which are covered in a separately bound meter instruction book.

Dimensions for both panel and wall mounting of the flow controllers are given in this separate meter instruction book.

Control piping connections should be made as indicated by the pipe diagram specified on the data sheet. The controller is provided with $\frac{1}{8}$-inch pipe taps for air pressure connections. Details of air piping are given by section AC 001 of these instructions.

CALIBRATING ADJUSTMENTS

Reference to Figure 7 will show adjustments which have been indicated by letters A and B. These adjustments have been fixed during the calibration of the controller at the factory. It will not be necessary to alter these adjustments except on replacement of the Pilotrol assembly or the drive arm of the flow mechanism.

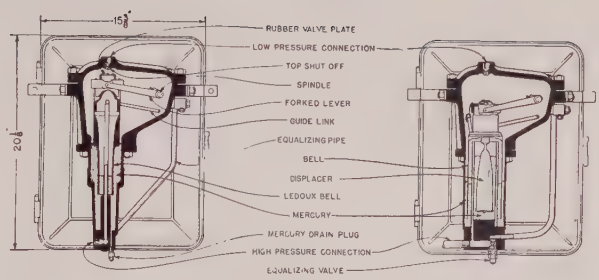
These adjustments have been made so that a reading of 15 is obtained on the loading pressure gage when the recording pen and the standard indicating pointer are coincident. Mid-chart position of the standard pointer should correspond to mid-chart position of the standard sector on the Pilotrol.

When two or more controllers are used in a control system to establish a composite control pressure by combining individual loading pressures in an averaging relay, the standard indicating pointers are omitted from the individual controllers. Each controller is calibrated for the required range in loading pressure. This range may be 5 to 25 lb. loading pressure for 0 to 100% chart or for some other percentage of full chart.

The calibration of the Pilotrol linkage is included on Page 5 of the Pilotrol instructions, section AC 100.

When making these adjustments the bell or bellows assembly of the meter may be disconnected from the driving arm and the driving arm blocked so that the pen is at the desired position on the recording chart.

The flow mechanism of this controller has been calibrated at the factory. In case it is desired to check the calibration or make any adjustments on the flow mechanism, reference should be made to the meter instructions covering this recorder-controller.

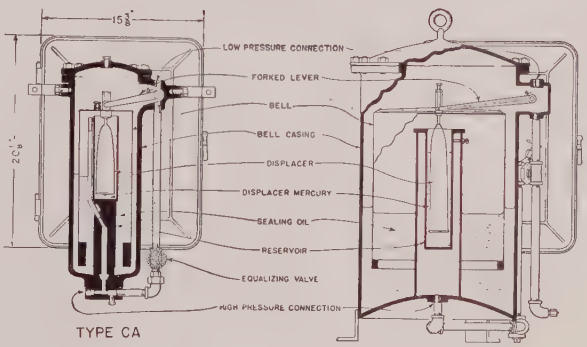


TYPE C

FIGURE 2 — Ledoux bell sealed in mercury.

TYPE CH

FIGURE 3 — Straight walled bell sealed in mercury with specially shaped displacer immersed in mercury.

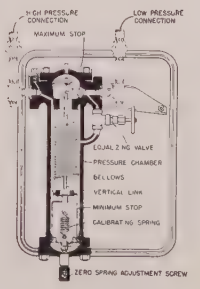


TYPE CA

FIGURE 4 — Straight walled bell sealed in oil with specially shaped displacer immersed in mercury.

TYPE CG

FIGURE 5— Large straight walled bell sealed in oil with specially shaped displacer immersed in mercury.



TYPE CS

FIGURE 6 — Operated by flexible metal bellows. Records on non-uniformly graduated chart.

MAINTENANCE

1. The adjustment and maintenance of the pilotrol is covered by Section AC 100.
2. The connecting linkage, pinion and gears should operate freely without binding. If any parts are found to have undue friction, remove the affected parts and clean with a common solvent such as carbon tetrachloride.
3. The air pressure connections and piping must be kept air tight since very small leaks will cause considerable error in the loading pressure, and erratic control operation.
4. The Pressure Gages should give correct readings or be replaced.
5. Reference should be made to Figure 7 and Section AC 100 for replacement parts.

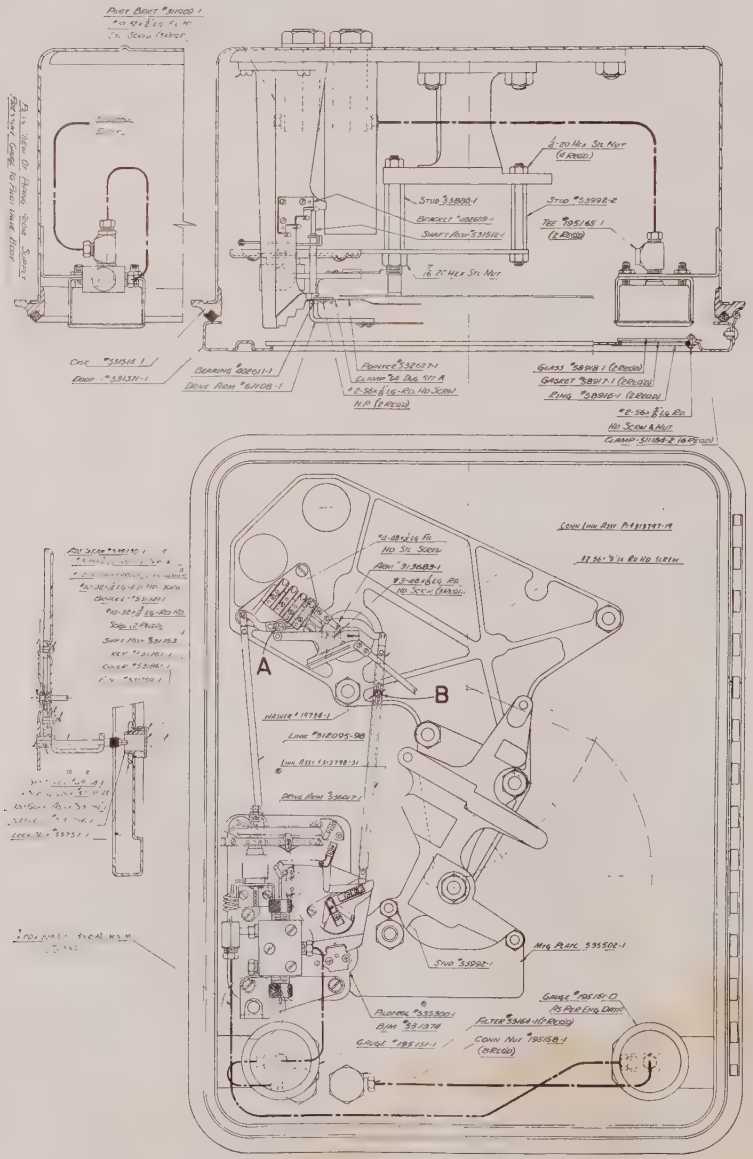
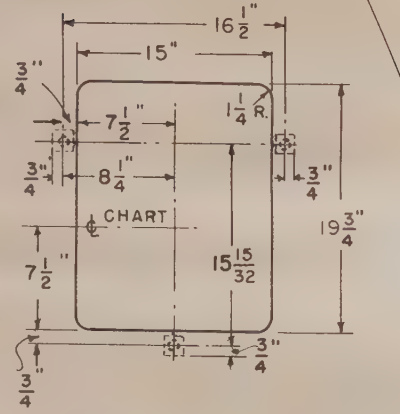
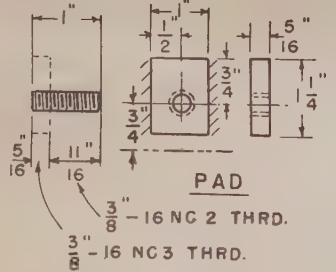


FIGURE 7 — General Assembly of Bailey Flow Recorder.





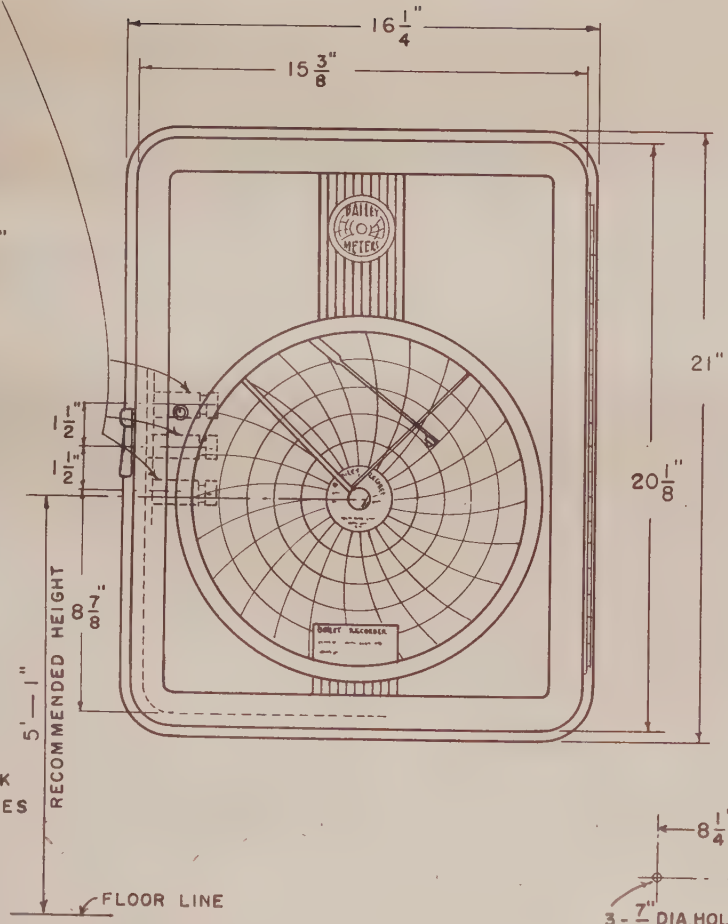
PAD

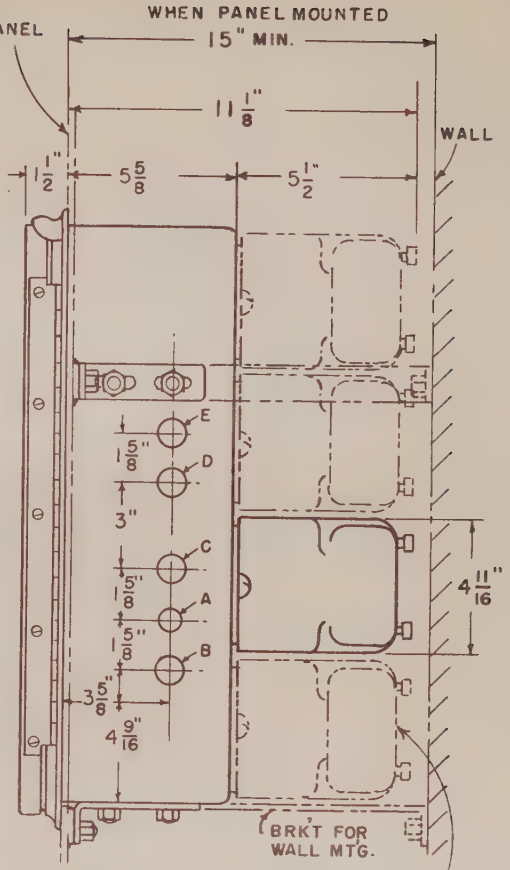
STUD AND PAD ASSEMBLY.

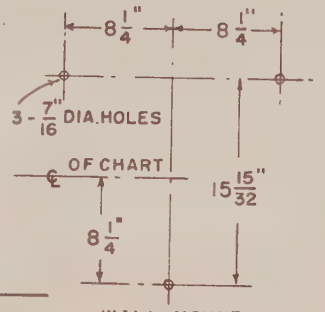
NOTE :- PADS ARE WELDED TO BACK OF PANEL. ARC WELD ALONG EDGES AS SHOWN.

STUD AND PAD ASSEMBLIES BY CUSTOMER.

FILTERS AIR CONTROL CONNECTIONS 1/8" PIPE TAP OMIT WHEN NOT CALLED FOR.







NO OF PENS	USE HOLES
1 PEN	A & C
2 PENS	A, C & D
3 PENS	A, C, D & E
4 PENS	A, B, C, D & E

HOLE A FOR 1/2" CONDUIT

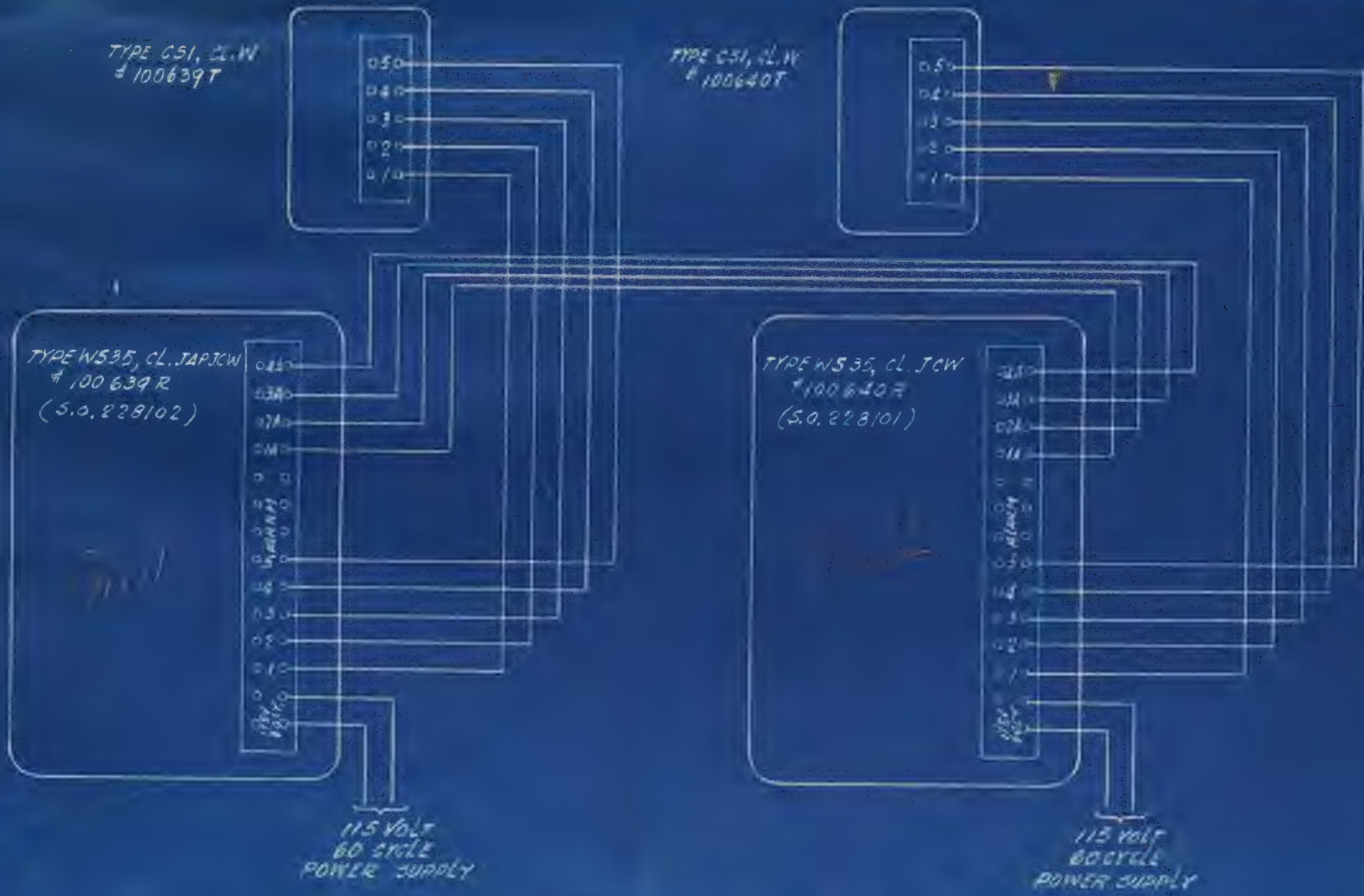
HOLES B, C, D AND E FOR 3/4" CONDUIT.

BAILEY ELECTRONIC TYPE RECORDER

TYPE_____ CLASS _____

BAILEY METER CO.
CLEVELAND, O. 6-13-45
SUB.171 DWG. NO. A304762-I

PRINTED IN U.S.A.



ELECTRONIC TELEMETER EXTERNAL WIRING DIAGRAM

FOR

CALIFORNIA INSTITUTE OF TECHNOLOGY

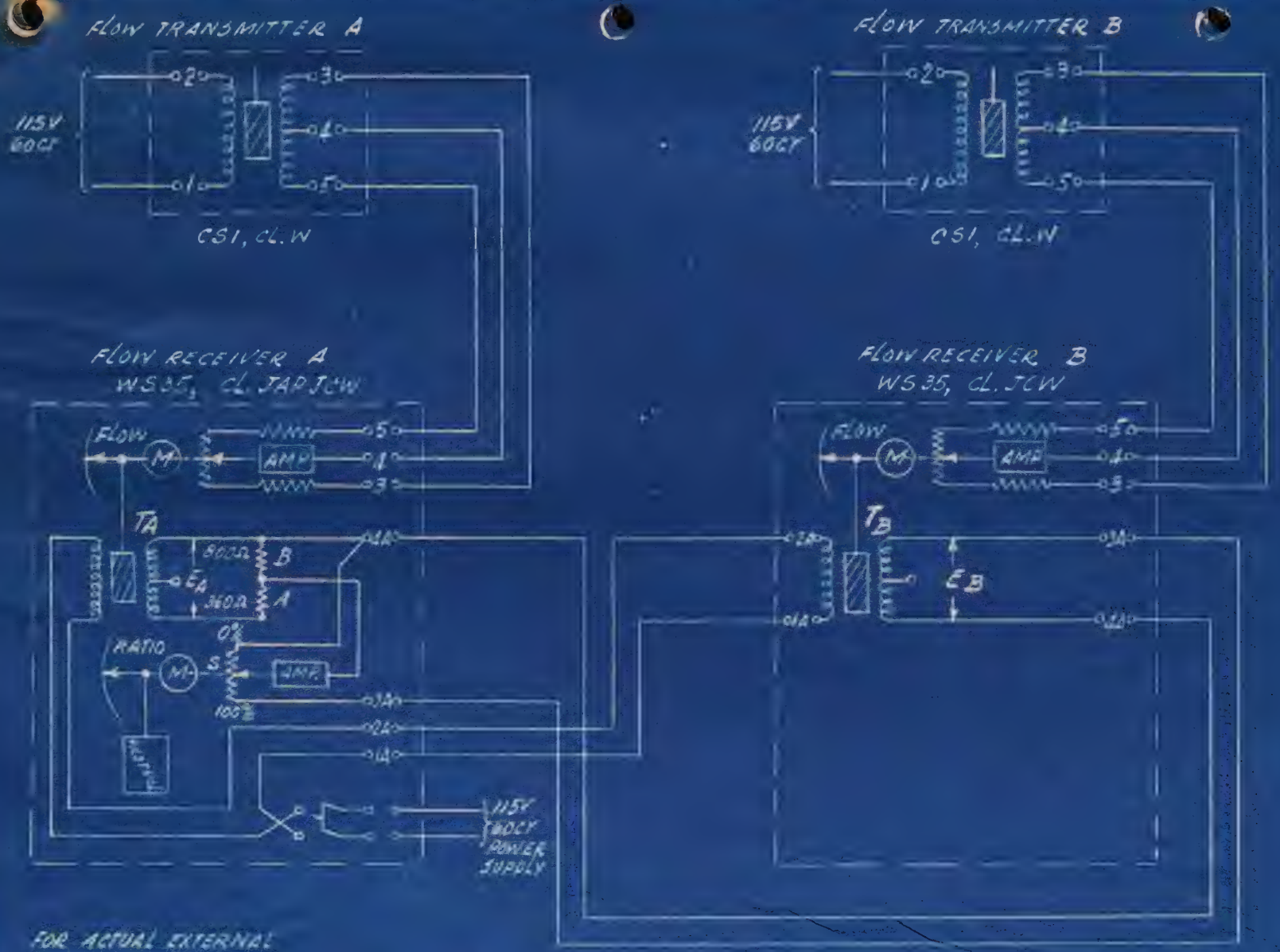
PASADENA, CALIFORNIA

BAILEY METER CO.

CLEVELAND, OHIO

DATE 10-19-45 BY MJ

DWG. NO. A 507451-A

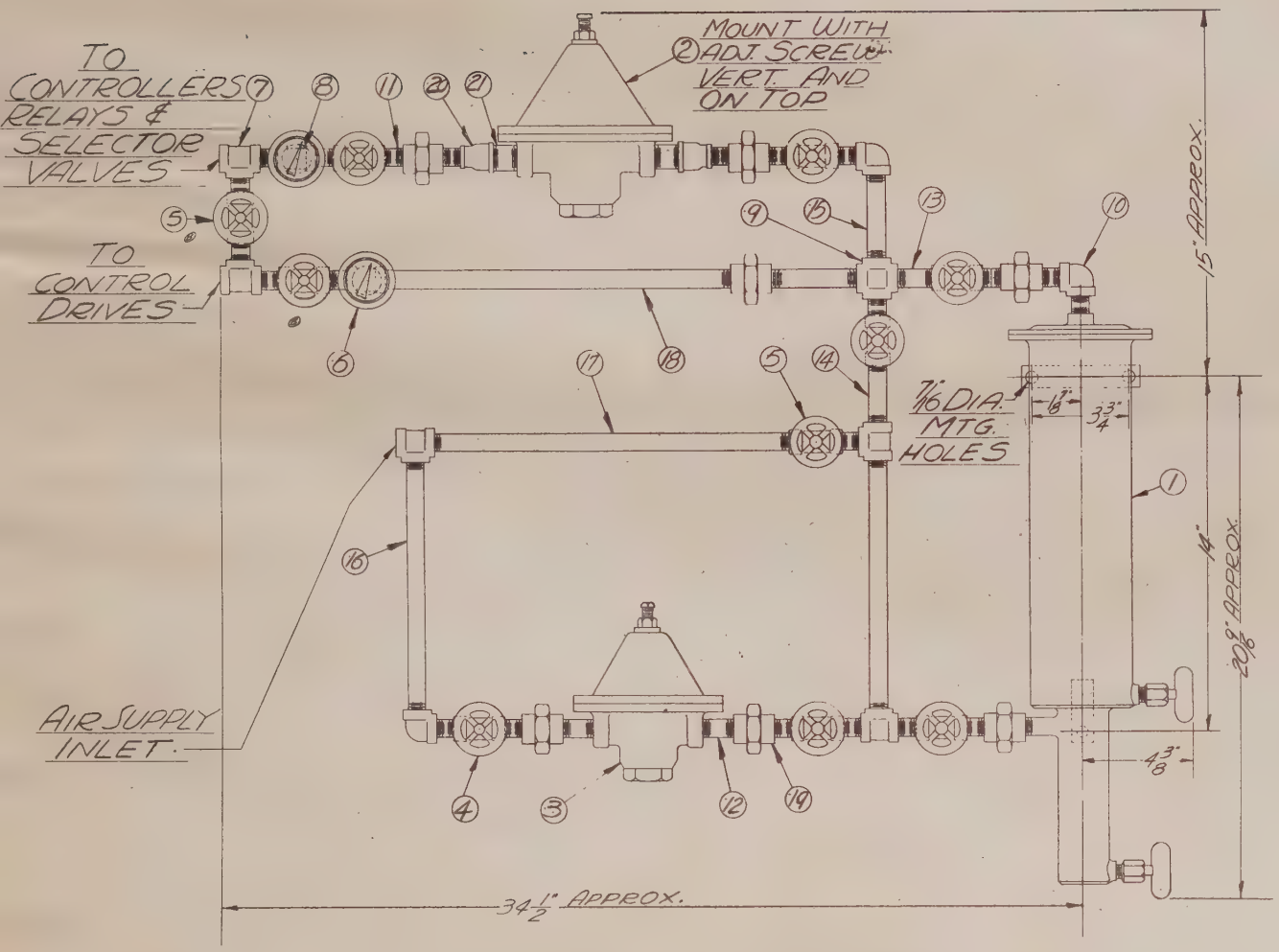


FOR ACTUAL EXTERNAL WIRING DIAGRAM, SEE DWG. No. A 507451

SCHEMATIC WIRING DIAGRAM
FOR
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

S.O. 33101-1-2

BAILEY METER CO.
CLEVELAND, OHIO
DATE 12-13-45 BY WG
DWG. NO. A 507452 B



FOR A COMPLETE LIST OF PART NUMBERS SEE B.M. # 531667. PART # 195431-1 INCLUDES ITEMS # 4 TO 21 INCLUSIVE.

ITEM	QUANTITY	DESCRIPTION
21	2	¾" BRASS NIPPLE 2" LG.
20	2	¾ × ⅜" BRASS REDUCER
19	1	⅜" STD. BRASS UNION
② 18	1	⅜ BRASS PIPE 14 7/16" LG. THD. BOTH ENDS
17	1	⅜ BRASS PIPE 14 13/16" LG. THD. BOTH ENDS
16	2	⅜ BRASS NIPPLE 10½" LG.
② 15	2	⅜ BRASS NIPPLE 4 1/4" LG.
14	1	⅜ BRASS NIPPLE 2 7/8" LG.
13	1	⅜ BRASS NIPPLE 2 1/8" LG.
12	2	⅜ BRASS NIPPLE 2" LG.
11	2	⅜ BRASS NIPPLE 1½" LG.
10	3	⅜ STD. BRASS ELBOW
9	1	⅜ STD. BRASS CROSS
8	2	⅜ × ⅜ × ⅜ BRASS TEE
7	5	⅜ STD. BRASS TEE
6	2	PRESSURE GAUGE # 195151-4
5	2	GLOBE TYPE VALVE # 195187 ⅜
4	8	CHAPMAN GATE VALVE # 195145 ⅜
3	1	REDUCING VALVE # 195168 ⅜
2	1	REDUCING VALVE # 195168 ¾
1	1	AIR FILTER # 535715-1

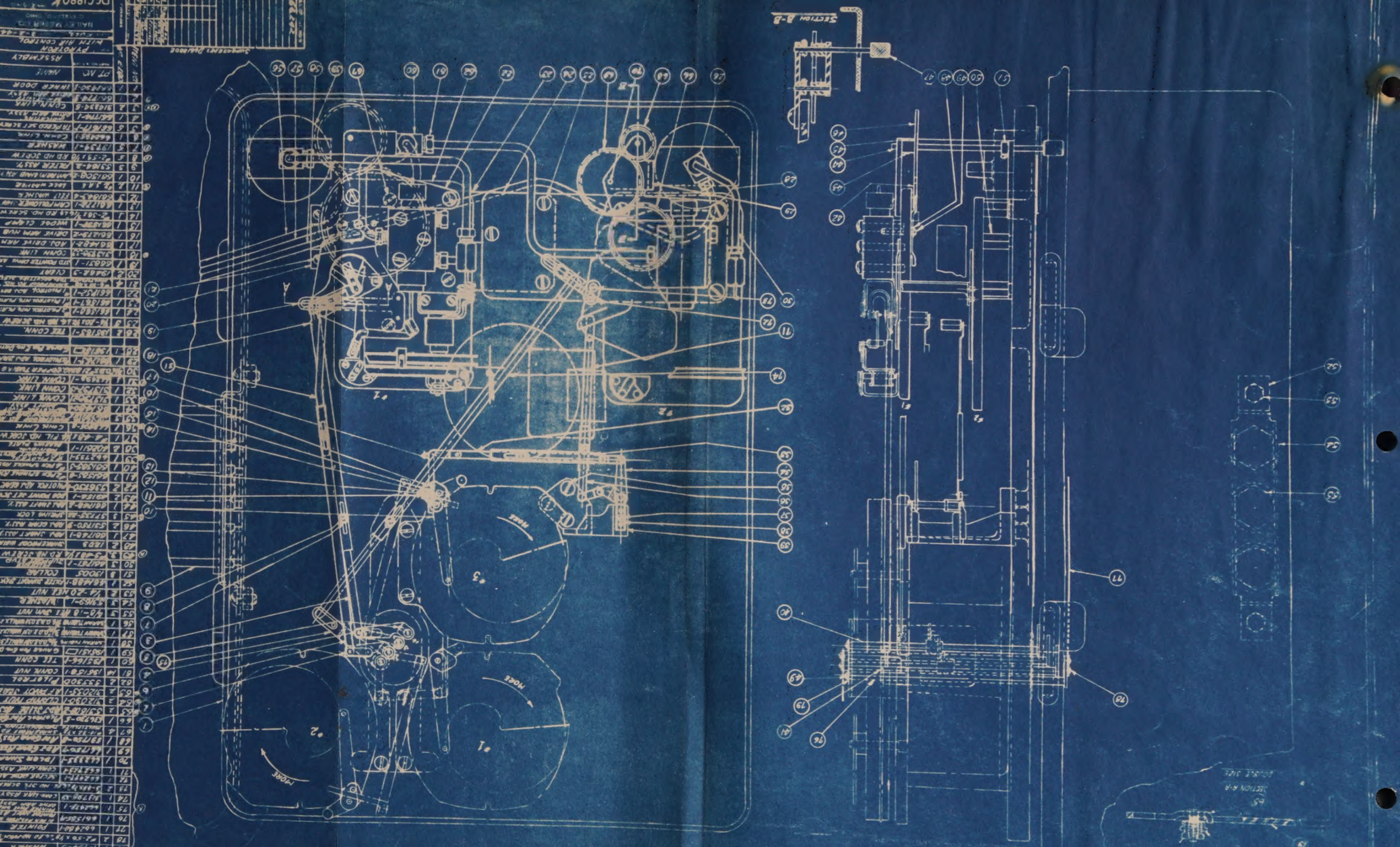
FILTER, REDUCING VALVES AND PIPING ASSEMBLY

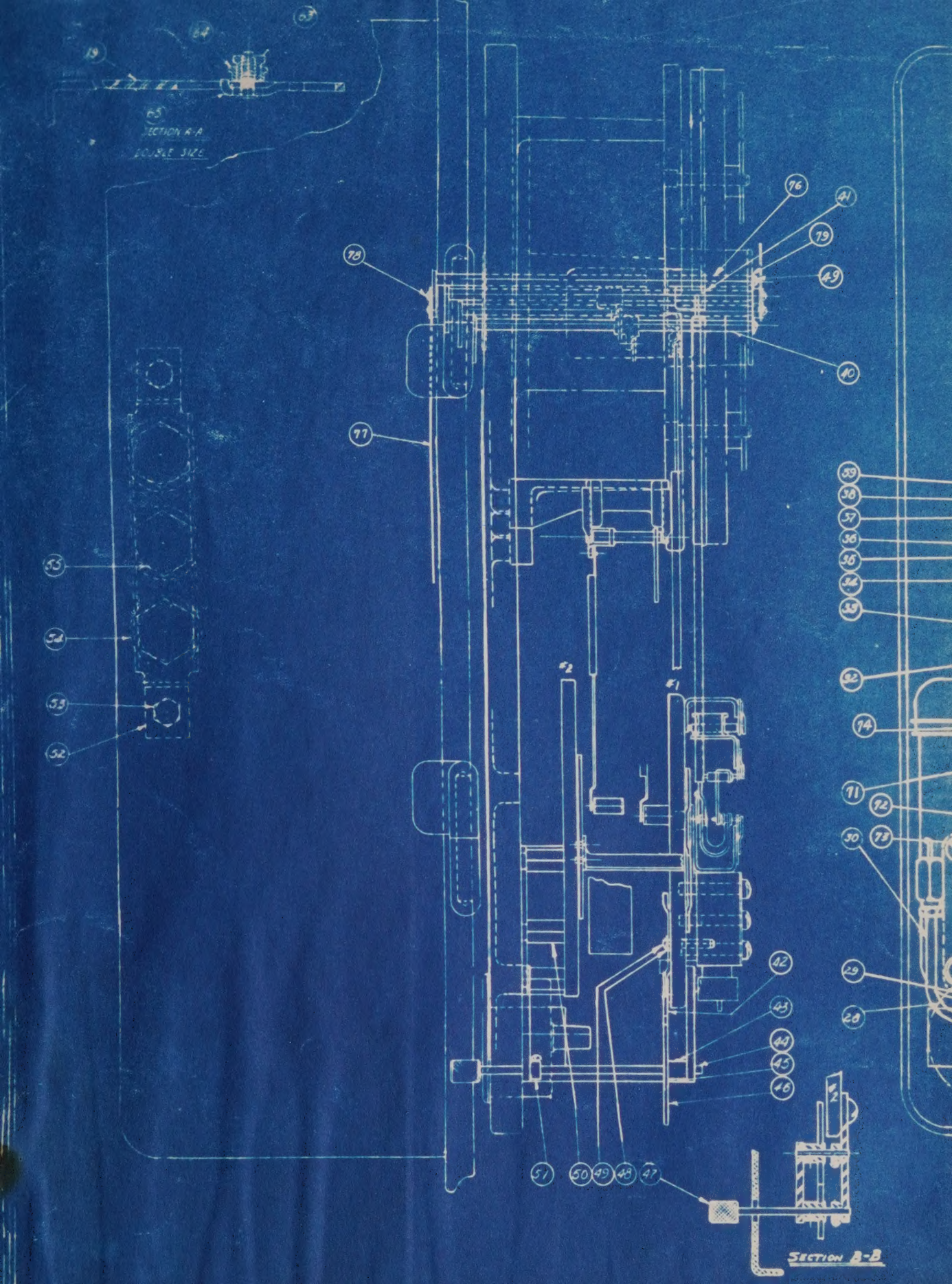
FILTER CAPACITY 6 CU. FT. PER MIN.

SUB NO. 551

BAILEY METER CO.
CLEVELAND, OHIO 2-25-42
D 536 552 B

PRINTED IN U.S.A.




SECTION A-A
DOUBLE SIZE
SECTION B-B

REAR VIEW

1.58 GR FLUID FLOW RECORDER & RATIO CONTROLLER TYPE WS35 CL. JAP JCW

1.04 GR FLUID FLOW RECORDER TYPE WS35 CL. JCW

Fuel

RELAY CONTROL LOADING SUPPLY A62-4

A60-4 FUEL OXIDIZER

1.58 SP. GR.

A1

VOLUME CHAMBERS

PRESSURE GAGES

3/4" REDUCING VALVES

AIR FILTER

O - VALVES NORMALLY OPEN
C - VALVES NORMALLY CLOSED

70-100 # AIR SUPPLY

3/8" REDUCING VALVE

ADJUST REDUCING VALVES FOR 28# AT GAGE "A" & FOR 40# AT GAGE "B".

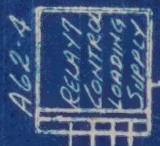
FILTER PIPING PER DWG D536552

1½" CONTROL VALV
STYLE XWFK 9
(1.58 GR. FLUID)

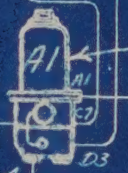
AS SHOWN

OXIDIZER

1.04 SP. GR



SELECTOR VALVES TYPE AS NOTED



STANDATROLS

SUPPLY LINES BETWEEN RELAYS & SHUT OFF VALVES MUST BE REMOVABLE FOR ADJUSTMENT OF INLET VALVES.

NOTE

¼" O.D. COPPER TUBING REQUIRED FOR ALL LOADING LINES. SUPPLY HEADERS AS INDICATED OR FOR OTHER HEADER ARRANGEMENTS DO NOT SUPPLY MORE THAN TWO UNITS THROUGH ¼" TUBING, EIGHT UNITS THROUGH ½" TUBING NOR TWENTY-FOUR UNITS THROUGH ¾" TUBING.

SYMBOLS

¼" O.D. ½" O.D.

⅜" BRASS PIPE

1" RATIO REGULATING VALVE STYLE XWFS-9 (1.04 SP. GR FLUID)

REV.	CHANGE	DATE

CONTROL PIPING DIAGRAM
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, 4 CALIF

BAILEY METER CO.
CLEVELAND, OHIO DATE 10-5-45
Dwg. No. B 50716 A A

S.O. 228101-6